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The Engineer.

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VOL. CXXXV.—No. 3507] LONDON: FRIDAY EVENING, MARCH 16, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. STEEL TYRES for ENGINES and TENDERS.
2. STEEL CRANK and STRAIGHT AXLES for LOCOMOTIVES.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Tuesday, the 10th April, 1923.

T. RYAN,
Director-General.
1828

RESEARCH APPOINTMENT UNDER THE MINES DEPARTMENT.

The Secretary for Mines invites APPLICATIONS for a POST under the Safety in Mines Research Board. The appointment is a whole-time one, and the provisions of the Federated Universities Superannuation Scheme apply. The salary, including superannuation contributions and all other emoluments, will depend upon the qualifications of the candidate selected and will not exceed £2000 per annum.

Candidates must possess high general scientific qualifications and experience in engineering, and a knowledge of coal mining will be a recommendation. The holder of the appointment will be required to advise the Board on questions of research in regard to the safety problems of coal mining, to prepare programmes of research, to organise and superintend research work, and generally to co-ordinate the scientific work of the Board. It will also be his duty to prepare a scheme for the centralisation of the research work of the Board in a permanent station.

Applications, which should be addressed to the UNDER SECRETARY FOR MINES, Mines Department, Dean Stanley-street, London, S.W. 1, should reach that address not later than 30th April, 1923.

19th March, 1923. G.78
1839

In the High Court of Justice, No. 00618 of 1922.
Chancery Division,
Mr. Justice Astbury.
In the Matter of the LUNE VALLEY ENGINEERING COMPANY Limited and Reduced,
and
In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that the ORDER of the High Court of Justice Chancery Division dated the 27th day of February 1923 CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £20,000 to £7304 4s., and the MINUTE approved by the Court showing with respect to the Share Capital of the Company as altered the several particulars required by the above Act were REGISTERED by the Registrar of Companies on the 12th day of March, 1923.

The said Minute is in the words and figures following :—

"The Capital of the Lune Valley Engineering Company Limited and Reduced was by an Order of the High Court of Justice dated the 27th day of February 1923 reduced from the former Capital of £20,000 divided into 20,000 shares of £1 each to £7304 4s. divided into 15,364 shares of one shilling each and 6636 shares of £1 each of which at the date of the registration of this Minute 13,364 Ordinary Shares of one shilling each had been issued and the full amount of one shilling had been and was to be deemed to be paid up thereon and none of the said 6636 shares of £1 each had been issued.

A Special Resolution of the Company has been passed and confirmed to the effect that on such reduction taking effect each of the said 6636 shares of £1 each be divided into 20 shares of one shilling each."

The reason for the reduction of the capital of the Company is that the Company has suffered loss by :

(a) The decrease in value of its premises at Glasson Dock, Lancashire, since the construction thereof in 1919.

(b) The depreciation in value of the Company's principal works at Meeting House Lane, Lancaster.

(c) Depreciation in value of stock.

Dated this 14th day of March, 1923.

BELL, BRODRICK and GRAY,
95, Queen Victoria-street, E.C. 4,
Agents for HALL MARSHALL and SEWART,
Lancaster,
Solicitors for the Company.
1818

In the High Court of Justice, 1923. G. No. 010.
Chancery Division,
Mr. Justice Astbury.
In the Matter of GEORGE CLARK Limited and Reduced
and
In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a PETITION presented to the High Court of Justice on the 5th day of February 1923 for CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £300,000 divided into 300,000 Shares of £1 each to £106,000 divided into 106,000 Shares of £1 each by returning to the Shareholders paid up capital in excess of the wants of the Company to the extent of £194,000 is directed to be heard before Mr. Justice Astbury on Friday the 23rd day of March 1923.

Dated the 14th day of March 1923.

POTHECARY and CO.,
1, Gresham-buildings, Basinghall-street, E.C. 2,
Agents for
MANN, LONGDEN and MANN,
of Somerford Buildings, Sunderland,
Solicitors for the above-named Company.
P7004

MANCHESTER MUNICIPAL

COLLEGE OF TECHNOLOGY

APPOINTMENT OF INSTUCTOR IN THE MECHANICAL ENGINEERING WORKSHOPS.

Applications are invited for the position of Instructor in the Mechanical Engineering Workshops of the College at a salary of £325 per annum. The person appointed will be required to give practical instruction in fitting, turning, and such machine work as generally obtains in Engineering Workshop Practice. It is desirable that applicants should hold the 1st class Teacher's Certificate in Manual Training (Metal-work) of the City and Guilds of London Institute.

Applications giving full particulars of qualifications, with copies of not more than three recent testimonials, should be forwarded to the Registrar of the College on or before 24th March, 1923. 1819

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Electric Generating Station at Comines—No. II.

Handling Sewage with a Centrifugal Pump.

Mechanically Operated Winches.

Utilisation of Exhaust Steam in Locomotives.

The Institute of Metals.

Bombay Water Supply—No. I.

Reinforced Plywood.

The Cable Ship Faraday.

PUBLIC NOTICES

Cape Technical College, Cape TOWN.

APPLICATIONS are invited for the following POST :—

LECTURER in MECHANICAL ENGINEERING, salary £400-25-600.

Applications, which will be received up to the 31st March, 1923, must be accompanied by certified copies of testimonials of training and teaching experience and should state age of applicant. Holders of such posts may be required to join the Government Provident Scheme. Two years' probation, subject to six months' notice on either side; afterwards, three months' notice. £50 allowed for travelling expenses, but a proportionate amount of this to be repaid if the contract is terminated in less than two years. Long leave after six years, three months on full, three months on half salary.—Applications to be sent to Messrs. CHALMERS, GUTHRIE and CO., Ltd., 9, Idol-lane, London, E.C. 3. 1831

Belfast Harbour.

The Belfast Harbour Commissioners are prepared to receive TENDERS from competent Dredging Contractors for the work of DREDGING, CONVEYING and DEPOSITING certain MATERIALS within and in the neighbourhood of the Port and Harbour of Belfast.

Specification, form of Tender, and any further information may be obtained from the Harbour Engineer, Mr. T. S. Gilbert, M. Inst. C.E.

Sealed Tenders, on the special form provided for the purpose, should be addressed to the undersigned, endorsed "Tender for Dredging, Conveying, and Depositing Dredged Material," and delivered not later than Wednesday, the 28th March, 1923.

The Commissioners do not bind themselves to accept the lowest or any Tender.

M. J. WATKINS,
General Manager and Secretary.
Harbour Office, Belfast,
7th March, 1923. 1806

Corporation of Calcutta.

NOTICE TO CONTRACTORS.

The TIME for the SUBMISSION of TENDERS for the SUPPLY, ERECTION, and INSTALLATION of an AERIAL ROPEWAY for the removal of the city refuse has been EXTENDED from 30th April, 1923, to 1st JUNE, 1923. Tenders must reach the Deputy Chairman, Corporation of Calcutta, 5, Corporation-street, on or before 2 p.m. on Friday, the 1st June, 1923, instead of Monday, the 30th April, 1923, as previously advertised.

JAMES R. COATS, B.Sc., M.I.C.E.,
Chief Engineer.
Central Municipal Office,
20th February, 1923. 1816

The South Indian Railway Com- PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—

2 "S.P." Class LOCOMOTIVE ENGINES and TENDERS (Broad Gauge).
5 "K" Class LOCOMOTIVE ENGINES and TENDERS (Broad Gauge).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Locomotives," must be left with the undersigned not later than Twelve Noon on Friday, the 13th April, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £2 for each copy of the specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3 Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
12th March, 1923. 1885

PUBLIC NOTICES

County of London.

The London County Council invites TENDERS for the ROAD WORK and FLAT-LAYING required for the construction for the overhead system of traction of the authorised tramway in Amhurst Park, from Seven Sisters'-road to Stamford Hill, and for the RECONSTRUCTION and WIDENING of the BRIDGE carrying Seven Sisters'-road over the New River. The paving of the breasts of the carriage-way along the route length will also be included in the contract.

The contractor will be required to use the rails with their fastenings, and the special work for the various crossovers, &c., which will be provided by the Council under other contracts, but all the remaining metal work and other materials will be included in the contract.

Persons desiring to Tender may obtain the specifications, bills of quantities, forms of Tender, drawings, &c., on application to the Chief Engineer of the Council, at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £5. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. Full particulars of the work and conditions of contract may be obtained at the Old County Hall before payment of this fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 9th April, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1863 Clerk of the London County Council.

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form, specification, contract conditions and drawings may be obtained or inspected at the office of

The Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION No. 23/23.—WATER SCREENING PLANT.

Prospective tenderers without Australian representation should note that time does not permit of their detailed Tender being received at this office by date of closing of Tenders, and should therefore cable direct the following particulars :—

1. Price.
2. Delivery.
3. Particulars marked with an asterisk in the schedule of plant details.
4. Whether or not one set may be delivered before the complete plant, and, if so, at what date.

Detailed Tender, on prescribed form, should be posted by earliest possible mail.

The Commission does not bind itself to accept the lowest or any Tender.

R. LIDDELOW,
Secretary.
State Electricity Commission of Victoria.
1641 Melbourne, Australia.

SITUATIONS OPEN

WANTED, BOILER SALESMAN; Chief Duties, estimating and correspondence.—Reply, stating age, salary required, and when available, to COCHRAN and CO., Annan, Ltd., Boilermakers, Annan. 1844 A

WANTED, ENGINEER, with Practical Knowledge of Oxygen, Liquid Air, or ice-making Plants. State experience, wage, &c.—Address, 1842, The Engineer Office. 1842 A

WANTED IMMEDIATELY, London District, Up-to-date DESIGNEE of CENTRIFUGAL and TURBINE PUMPS, with all-round experience; good scope for energetic man.—Address, stating qualifications, age, and salary, 1826, The Engineer Office. 1826 A

PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	COPPER PLATES and PHOSPHOR COPPER	10s.
2.	SPARE PARTS of LOCOMOTIVE ENGINES	10s.
3.	FERRO-PRUSSIATE PAPER, &c.	2s. 6d.
4.	FIRE-BRICKS	2s. 6d.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Copper Plates, &c.," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 27th March, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.
Company's Offices,
43, Copthall-avenue, E.C. 2,
London, 14th March, 1923. 1838

Shanghai Municipal Council. PUBLIC WORKS DEPARTMENT.

ASSISTANT ENGINEER.

A fully qualified ASSISTANT ENGINEER is REQUIRED in the Public Works Department of the Shanghai Municipal Council. Candidates must be between 28 and 32 years of age and unmarried. They should hold the testamur of the Institution of Municipal and County Engineers or have passed the examination for the associate membership of the Institution of Civil Engineers, or hold a degree in engineering from a university in Great Britain. They should also have had at least two years' experience on constructional works.

Salary Taels 400 per mensem, under a three years' agreement, which is renewable at a higher salary in the event of satisfactory services. First-class passage is granted, with half-pay during voyage. Free medical attendance is provided, and the employee participates in the benefits of a superannuation fund. A tael at the present rate of exchange equals 2s. 1d.; exchange is, however, subject to fluctuation. Taels 400 per mensem at exchange 2s. 1d. is equivalent to about £740 per annum.

Particulars of the appointment and also full details as to the benefits enjoyed by municipal employees under their terms of service may be obtained from the Council's Agents, and applications, in candidates' own handwriting, with full information as to experience, &c., accompanied by copies of at least three recent testimonials and endorsed "Assistant Engineer" on the cover, should be forwarded at the earliest possible moment to

Messrs. JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
6B, Fenchurch-street,
London, E.C. 3,
March, 1923. 1780

Shanghai Municipal Council. PUBLIC WORKS DEPARTMENT.

CLERKS OF WORKS.

FOUR fully qualified CLERKS of WORKS are REQUIRED in the Public Works Department of the Shanghai Municipal Council. Candidates must be about 30 years of age and unmarried. Preference will be given to applicants thoroughly experienced in sewer construction and general engineering work. Salary Taels 225 per mensem, under a three years' agreement, which is renewable at a higher salary in the event of satisfactory services. Second-class passage is granted, with half-pay during voyage. Free medical attendance is provided, and the employee participates in the benefits of a superannuation fund. A tael at the present rate of exchange equals 2s. 1d.; exchange is, however, subject to fluctuation. Taels 225 per mensem at exchange 2s. 1d. is equivalent to about £627 per annum.

Particulars of the appointments and also full details as to the benefits enjoyed by municipal employees under their terms of service may be obtained from the Council's Agents, and applications, in candidates' own handwriting, with full information as to experience, &c., accompanied by copies of at least three recent testimonials and endorsed "Clerk of Works" on the cover, should be forwarded at the earliest possible moment to

Messrs. JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
6B, Fenchurch-street, E.C. 3. 1749

PUBLIC NOTICES (continued) Page 2.

"THE ENGINEER" WANTED.

WANTED, "THE ENGINEER," Vol. No. 129, January to June, 1920, and ONE COPY dated November 21st, 1919.—Address, P2000, The Engineer Office. P2000

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SITUATIONS WANTED, Page 2.
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FOR SALE, Pages 3 and 4.
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AGENCIES, Page 2.
MISCELLANEOUS, Page 2.

For Advertisement Rates See Page 289, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page 87.

PUBLIC NOTICES

Chesham Urban District Council.

The Chesham Urban District Council invite APPLICATIONS from qualified engineers with special experience in drainage for the POST of ENGINEER in connection with the work of thoroughly Overhauling, Examining, and Re-laying or Repairing and generally Improving the Sewerage System and House Connections in the Urban District. The work will be done by day labour and the person appointed will be responsible for the engaging and control of labour, the keeping of the necessary labour sheets, books and accounts, and will be required to attend the Auditor in connection therewith. An office and all office requisites will be provided.

The person appointed will be required to reside within the Urban District and to devote his whole time and attention to the duties and be directly responsible to the Council for the performance thereof.

The salary will be at the rate of £600 per annum and the appointment will be determinable by one month's notice from either side.

Applications, stating age and qualifications, with particulars of experience in the kind of work to be undertaken by the Council, and to be accompanied by copies of not more than three recent testimonials, to be sent to me not later than first post on Friday, the 30th March, 1923. Applications to be endorsed "Engineer."

W. J. STANDRING,
Clerk of the Council.

Chesham, Bucks.,
March, 1923. 1854

The Municipality of Singapore,

STRAITS SETTLEMENTS.

SECOND ASSISTANT GAS ENGINEER.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT GAS ENGINEER, age 28-32, of sound constitution and unmarried. The duties are to take charge of the outdoor work, including the laying of mains and services, the fixing, testing and repair of meters, the installation of gas in private houses and for public lighting, and in ordinary maintenance and distribution. Candidates must have some experience of gas manufacture and gasworks routine to enable them to assist in the gasworks in case of emergency. The appointment will be on agreement for three years with possible extension. The selected candidate must pass a medical examination as to his fitness for service in Singapore. A second-class passage will be provided by mail steamer, or a first-class passage by other steamer, with half salary during the voyage out. The salary will be 6000 dollars for the first, 6480 dollars for the second, and 6960 dollars for the third year, paid monthly, the value of the dollar being two shillings and fourpence sterling. For the first year the salary would be equal to £700 as above, with an allowance for such transport as may be required on duty. The selected candidate might be required to reside at the gasworks, where free unfurnished quarters would be provided. Applications, stating age and place of birth, and giving details of education, training, and experience generally, and in the use of gas appliances for domestic, industrial and power purposes, stating when free, accompanied by copies (only) of testimonials, and also personal references, to be lodged with Messrs. C. C. LINDSAY and PEIRCE, MM. Inst. C.E., 180, Hope-street, Glasgow, Agents to the Municipal Commissioners (from whom further information may be obtained), not later than Tuesday, 20th March, 1923. 1769

SITUATIONS OPEN (continued)

WANTED, MECHANICAL ENGINEER, About 30, Gentleman, A.M.I.C.E. or equivalent, thorough scientific education and attainments, workshop experience, first-class draughtsman, well up in Constructional steel work, the various types of Internal Combustion Engines, Air Compressing Machinery, Mechanisms, Electricity, Wireless; able to spend a day or two at work at sea. Probation about two years, £350; permanency, £950 to £500, plus in each case equivalent of Civil Service bonus, superannuation.—Address, 1755, The Engineer Office. 1755 A

WANTED, TOWN SUPERINTENDENT for Waterworks on East Coast. Population about 60,000. Experience in distribution, main laying, waste detection, keeping of pipe plans and records, plumbing, fittings, meters, stores and office routine. Good management of all classes of workmen. Salary £900 per annum with house. Age 30 to 45. Application in own handwriting, with three recent testimonials.—Address, 1756, The Engineer Office. 1756 A

AMBITIOUS FOUNDRYMEN, Iron and Brass, also ENGINEERS and DRAUGHTSMEN who are desirous of securing better positions should obtain "The Foundryman's Educator," giving mixtures of non-ferrous metals and alloys, irons and foundry productions. If it is your ambition to become foundry manager or a works manager or foreman, this book will guide you to secure one of these positions in life which you may be worthy of. Don't stand in your own way; write at once, as they are being rapidly taken up. Post free 6s. to any part of the world.

"FOUNDRYMAN'S EDUCATOR" Offices,
Harefield Hall, Heywood, Lancs. P7091 A

APPLICATIONS are WANTED for the POSITION of GENERAL MANAGER of Associated British Machine Tool Makers, Ltd.—Apply by letter, giving full particulars of qualifications, salary required, &c., to the CHAIRMAN, 17, Grosvenor-gardens, London, S.W. 1. 1864 A

ENGINEERING REPRESENTATIVE REQUIRED by Old-established Firm of Reinforced Concrete Specialists for Liverpool and district on commission and expenses basis. One or two other good class building trade agencies not objected to.

Knowledge of civil engineering essential.

Address, stating full particulars, P7102, The Engineer Office. P7102 A

HEATING and LIGHTING ENGINEERS, South Coast, REQUIRE a thoroughly competent, live WORKS MANAGER. Must be able to prepare schemes and estimates and also interview. Credentials and salary required.—Address, P7085, The Engineer Office. P7085 A

REPRESENTATIVE WANTED.—An Established firm making Ships' Fittings and Auxiliaries, invite APPLICATIONS from gentlemen with a genuine connection amongst shipbuilders, superintendents, &c., in the Clyde, Liverpool and Belfast districts.—Address, giving full particulars, stating age, salary required and reference, 1866, The Engineer Office. 1866 A

REQUIRED for a Period, MECHANICAL ENGINEER, to Take Charge of Ship Repairs, Reconditioning Machinery and Hulls; must have had good experience also in workshops and able to carry out work economically. State briefly experience and salary required.—Address, P7127, The Engineer Office. P7127 A

SMART MAN WANTED, Who Will PUSH SALE of BRIGHT NUTS amongst customers. Very good commission. Best quality guaranteed lock-nuts. Lowest possible prices.—Write, Z. K. 275, care Deacon's, Leadenhall-street, E.C. 3. 1843 A

THE ROYAL EXCHANGE ASSURANCE CORPORATION REQUIRE additional BOILER and ENGINE SURVEYORS. Age about 30, extra or first-class B.O.T. certificate necessary. Preference given to those with electrical experience. Commencing salary £260.—Address, stating qualifications, experience, together with reference, 1833, The Engineer Office. 1833 A

WANTED, a First-class DRAUGHTSMAN, with experience in the Design of Woodworking Machinery.—Write, stating age, salary, and experience, Box 2500, Willing's, 30, King-street, Covent Garden, W.C. 2. 1808 A

SITUATIONS OPEN (continued)

WANTED by Important Firm in the North DRAUGHTSMAN, with experience of Structural Steel Work; must be capable of preparing designs and estimates.—Address, P7114, The Engineer Office. P7114 A

WANTED IMMEDIATELY, by Leading Firm of Boiler Manufacturers (Midlands), a DRAUGHTSMAN, thoroughly experienced in Designs of Vertical and Loco. Type Boilers.—Address, giving full particulars of career and copies of testimonials, state salary required, and when at liberty, 1847, The Engineer Office. 1847 A

CHIEF DRAUGHTSMAN REQUIRED for Estimating Drawing-office of Structural Engineers. Must be able to take control of office and be fully qualified to Design and Estimate for all classes of Steel Structures on modern lines. Apply, stating age, experience, and salary required.—Address, "CHIEF," Wm. Porteous and Co., Advertising Agents, Glasgow. P7104 A

DRAUGHTSMAN ESTIMATOR REQUIRED for Elevating and Conveying Machinery Works near London. Only those with actual experience need apply. Send full particulars.—Address, 1818, The Engineer Office. 1818 A

DRAUGHTSMEN, Experienced in Railway Carriage and Wagon Work, REQUIRED by a leading Contract Shop.—Address, stating age, experience, and salary required, 1862, The Engineer Office. 1862 A

DRAUGHTSMAN REQUIRED; First-class Experience in Design of Chain and Travelling Grate Mechanical Stokers essential; only those possessing unquestionable experience need apply. Give details of experience and state salary required.—Address, P1849, The Engineer Office. P1849 A

DRAUGHTSMEN Used to Colliery Winding Machinery or Cement and Crushing Machinery WANTED by firm in North-West Lancashire. State age, experience and salary required.—Address, 1867, The Engineer Office. 1867 A

DESIGNER WANTED, London, for Foodstuffs Machinery. State experience and salary required. —Address, P7103, The Engineer Office. P7103 A

DRAUGHTSMAN.—WANTED, for North London, DRAUGHTSMAN. State experience, salary, &c. —Address, P7084, The Engineer Office. P7084 A

DRAUGHTSMAN WANTED for Steel Construction, Coal and Coke Handling and Storage Work. Able to arrange and design.—Apply by letter only, stating age, qualifications, and salary required, to ARTHUR DUCKHAM and CO. (1920), Ltd., 52, Grosvenor-gardens, London, S.W. 1. 1801 A

DRAUGHTSMAN WANTED for Midlands District, thoroughly conversant with Design of Steam Engines and Pumping Machinery. Progressive position for suitable man. Must have had works experience.—Address, stating age, experience, and salary required, 1861, The Engineer Office. 1861 A

DRAUGHTSMAN WANTED for London Office; must be thoroughly experienced in the Design of Light Steel Structures, and some mechanical knowledge.—Address, giving particulars of training and experience, age, and salary required, 1857, The Engineer Office. 1857 A

JIG and TOOL DRAUGHTSMAN REQUIRED by a well-known firm of Heavy Vehicle Manufacturers. Applicants must have had a wide experience and have held similar position and be able to design jigs of single and multi type which are fool-proof and also quick and accurate in operation. Only first-class man need apply. Send full particulars, enclosing copies of recent testimonials, and state salary required. —Address, 1803, The Engineer Office. 1803 A

LOCOMOTIVE DRAUGHTSMEN, Experienced, WANTED for Manchester district.—Address, giving full particulars, including age, salary required, &c., 1858, The Engineer Office. 1858 A

MECHANICAL DRAUGHTSMEN WANTED (with some Electrical Knowledge preferred). Men of first-class ability, workshop and technical training and sound experience; N.W. London. Good openings for first-class men.—Address, stating age, experience, and salary required, 1851, The Engineer Office. 1851 A

SENIOR DRAUGHTSMAN WANTED; Large Engineering Firm in the Midlands; one used to Plant Lay-out and General Mill Work; experience in jig and tool design a recommendation.—Address, with full particulars and references, stating salary required, 1840, The Engineer Office. 1840 A

REQUIRED IMMEDIATELY, First-class FOREMAN for London, used to Heavy Excavation and Tunnelling under London streets. Send copies two last testimonials, state wages required, and when free.—Address, 1852, The Engineer Office. 1852 A

ENGINEERING FIRM REQUIRE Smart MAN, experienced in Drafting and Designing Advertisements and Catalogues and capable of Taking Charge of Publicity Department. Apply, giving full particulars of training and experience and stating salary required.—Address, "PUBLICITY," Wm. Porteous and Co., Glasgow. P7105 A

SITUATIONS WANTED

WANTED by EXPERT in COAL ECONOMY, a POSITION in Large Power Works similar to present position held in one of largest continental electricity stations. Knowledge of boiler-house testing and analysis work; trained London and continental power stations; satisfactory references, age 30, British, and public school education.—Address, P7099, The Engineer Office. P7099 B

ARC WELDING.—Practical WELDER MECHANICAL ENGINEER DESIRES POST, charge welding department. Sound experience as manager; carried out demonstration work.—Address, P7107, The Engineer Office. P7107 B

BOILERMAKER (23) SEEKS POSITION, Home or abroad; City Guilds and R. of E. certificates, boiler and platework.—Write, HUXLEY, 98, Cattedown-road, Plymouth. P7126 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 1761 B

CHIEF ENGINEER of IMPORTANT COMPANY DESIRES CHANGE.
Minimum salary £1000.
Address, P7026, The Engineer Office. P7026 B

CIVIL ENGINEER (42), with Twenty Years' Home, foreign and colonial experience, DESIRES APPOINTMENT. Highest qualifications and references.—Address, P7062, The Engineer Office. P7062 B

CONSTRUCTIONAL and MAINTENANCE ENGINEER (30) DESIROUS POST, works manager or with firm of consulting engineers; excellent experience in the erection of chemical, steam and electrical plants, steel, R/I concrete, gas producers, furnace work, D.O. and surveying; either at home or abroad; keen and energetic; good linguist.—Address, P7122, The Engineer Office. P7122 B

ENGINEER B.Sc. (Lond.), Assoc. M. Inst. C.E., A.C.G.I., formerly on staff of leading railway, now with constructional firm, DESIRES CHANGE with prospects. Fifteen years' experience all classes structural work. Entire responsibility, used control staff.—Address, P7004, The Engineer Office. P7004 B

SITUATIONS WANTED (continued)

ENGINEER DESIRES POST, Works Engineer or Foreman; experienced millwright, tool-room, machine, fitters and erectors' foreman, gas, steam, internal combustion, &c.; aircraft, hydraulic, D.O.—Address, P7110, The Engineer Office. P7110 B

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For continuation of Small Advertisements see page 3

The Central Electric Generating Station at Comines.

No. II.*

THE AUXILIARY PLANT.

THE motors which provide motive power for the auxiliary services of the generating station and of the pumping plant for the circulating water, as well as for the lighting of the establishment, take their current from a turbo-alternator set of 3500 kilowatt capacity. The turbine is a high-pressure Rateau machine which runs at 3000 revolutions per minute, and which normally operates with steam at the same pressure and of the same degree of superheat as do the main turbines. The alternator has a capacity of 3500 kilowatts and generates three-phase 50-period current at 10,500 volts. The current is supplied to bus-bars which feed :—

(1) The 2000 k.V.A. 10,500/220-volt transformers for the auxiliary services, which are operated by three-phase motors ;
(2) The transformers for the rotary converters for the services which are operated by direct current ; and
(3) The 1000 k.V.A. transformers in the pumping station.

The bus-bars can also be supplied with high tension current from the main generators in case of accident to the 3500 kilowatt set. It is proposed, eventually, to supplement the latter machine by installing another turbo-generator of 5200 kilowatt capacity.

The overhead travelling cranes, the transporter, the belt conveyors, the travelling hoppers, the bucket elevators, &c., are operated by direct current motors, which obtain their current from two six-phase, 50-period rotary converters with shunt excitation, each of which has a capacity of 500 kilowatts, and runs at a speed of 500 revolutions per minute. These converters are each run up to synchronous speed by means of an asynchronous motor, which is cut out of circuit by a centrifugal device when the proper speed has been attained. The transformers which supply current to these rotary converters are of 550 k.V.A. capacity, and have a transformation ratio of 10,500/172 volts.

The emergency lighting as well as the operation of the remote-control oil-immersed circuit breakers is brought about by means of a battery of iron-nickel accumulators having a capacity of 350 ampère hours. The current for charging this battery is furnished by a motor generator set consisting of a 220-volt three-phase motor of 24 horse-power, coupled direct to and on the same bed-plate as a shunt wound continuous current generator designed to deliver a current of 75 ampères at voltages varying between 110 and 160.

WATER SUPPLY AND STEAM PIPES

Water is used in the station for the following purposes :—

1. Feeding the boilers.
2. Condensing.
3. Cooling lubricating oil.
4. Cooling transformers and reactances.
5. The fire service.
6. Drinking.
7. Sanitary arrangements.

The boilers are fed on the closed-circuit system, the make-up water being purified and distilled before being used. There are two sources of water supply, the Lys, and a well sunk to a depth of about 190 m. —say 623ft.—into the carboniferous limestone. The Lys furnishes the circulating water for the condensers of the turbo-alternators and water for the distilling plant, as well as for the make-up water, the oil coolers and the fire service. The well water is used for the domestic supply of the workmen's village, though it may be used for make-up water and for other purposes if necessary. The motor driven centrifugal pumps for these different services, as well as the feed pumps and the hotwells, are housed in the same building as is the distilling plant. This building, which is 5 m. wide and 40 m. long, is of the same construction as the boiler-house. It has on its roof a water tank which is divided into three entirely separate compartments, two being of 65 cubic metres—14,300 gallons—and the third of 20 cubic metres—4400 gallons—capacity respectively. The 14,300-gallon tanks are filled either from the Lys or from the well, while the 4400-gallon tank is intended solely for distilled water.

There is a Delmouly-Lamy water purifier capable of dealing with 40 cubic metres, or 8800 gallons, per hour, which provides a large proportion of the water required to make up for the various losses in the different parts of the plant. It is only intended, however, that it shall operate for eight hours per day, so that the treated water as it leaves it is led into a sedimentation or decantation tank of 300 cubic metres—66,000 gallons—capacity. A second tank of similar capacity is used for the distilled water which is used for the cooling of the transformers and reactances. This distilled water circulates in a closed circuit and is cooled by means of spraying.

The distilling plant, which is of the Grimpage triple effect type and works under a vacuum, was supplied by the Kestner firm. The first element is heated by the steam escaping from the turbine-driven feed pumps, which has an absolute pressure of 2 kilos. per square centimetre—about 28½ lb. per square inch The continuous hourly output of this plant is some 2200 gallons per hour. It is measured by a Lea recorder and is delivered direct to the hotwells. The feed pumps, which are four in number, were made by Sulzer Brothers. Three of them are steam turbine-driven, while the fourth is worked by a 220-volt three-phase electric motor. Each pump can deliver 150 cubic metres—33,000 gallons—of water per hour against a pressure of 25 kilos. per square centimetre—356 lb. per square inch—and 200 cubic metres—say 44,000 gallons—under a pressure of 23 kilos. per square centimetre—or, say, 327 lb. per square inch. The suction inlets of these pumps are drowned in the hotwells, which each have a capacity of 21 cubic metres. The condensate from the turbines is also delivered to these hot-wells by centrifugal pumps. The feed pumps are each furnished with a safety device by means of which, if the pressure rises about 25 kilos. per square centimetre, the discharge is returned to the hotwell.

The steam piping, which was supplied by Pante and Masquelier, is of solid drawn mild steel. It is very carefully insulated by a covering 90 mm. thick of a composition made of up 85 per cent. "Newalls" carbonate of magnesia and 15 per cent. asbestos fibre. The arrangements are such that the turbines can be fed from any of the boilers, and the quantity of steam used is recorded by General Electric meters.

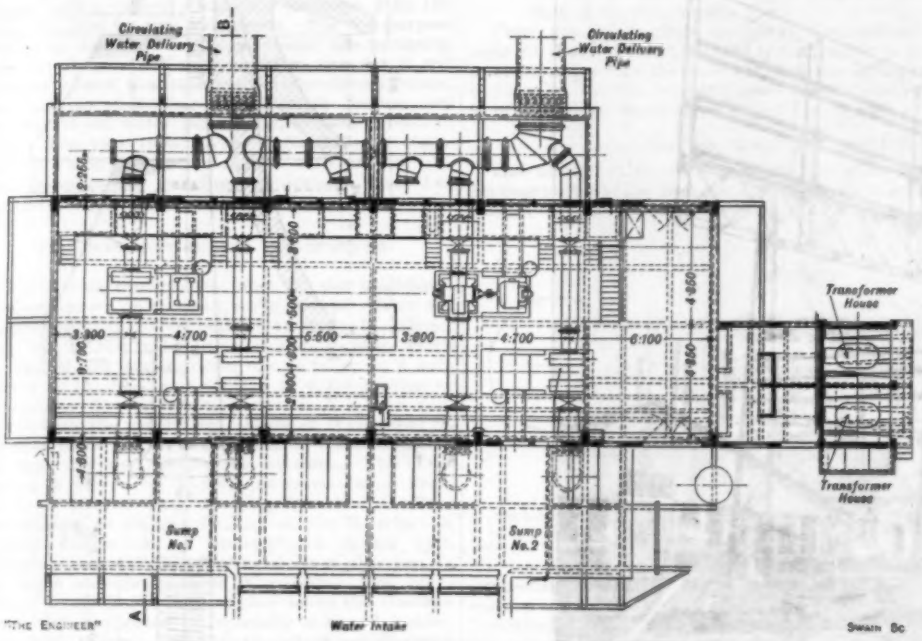


FIG. 13—PLAN OF CIRCULATING-WATER PUMP HOUSE

THE TRANSFORMER HOUSE.

The building containing the transformers and the switching arrangements is 56 m.—183ft. 9in.—long, and 28.4 m.—93ft. 2in.—wide. It is separated from the engine-room by means of a corridor 5.5 m.—18ft.—wide, which is reserved for the switchboard—see the sectional drawing Fig. 4 *ante*. The transformers are housed in cells on the ground floor of the building, the cells being furnished with ducts for air circulation. The switchgear is arranged in a room immediately above the transformer cells. Its floor is at the same level as is that of the engine-room. The transmission lines issue from the building at a height of 42ft. 6in. from the ground.

The terminals of each main generator are connected to two 10,500/45,000-volt step-up single-phase transformers, each of which has a capacity of 10,500 kilovolt-ampères. The secondaries of the transformers are in turn connected to three sets of 45,000-volt bus-bars by means of remote-control, electrically-operated, oil-immersed switches. Of the three sets of bars, one is for coupling purposes, another for the auxiliaries, while the third and principal set is for distribution. Reactances are inserted in the cables leading to the set of coupling bars. Circuit breakers inserted between the switches just mentioned and the extra high tension terminals of the transformers, provide a means of isolating any one of the generators in case of need. The operation of these circuit breakers is effected by means of two differential relays and of a third relay of the watt-meter type, which comes into play should any mistake be made in switching in either of the machines. The bus-bars are divided into sections by means of switches, so that, if deemed desirable, the machines may be connected to different transmission circuits. The different sections of the principal and auxiliary bus-bars are connected together by oil-immersed circuit breakers which are interlocked with mechanically controlled tripolar-sectionising switches.

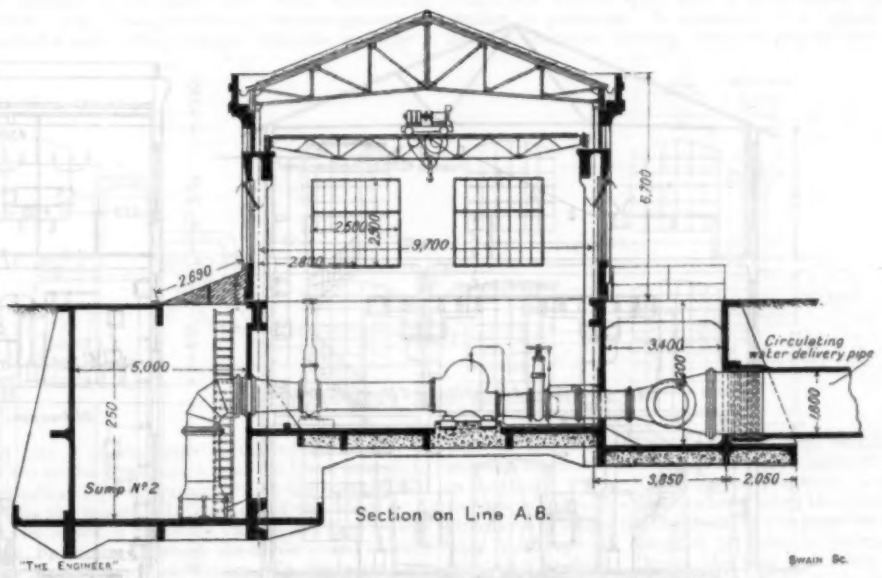


FIG. 14—SECTION THROUGH CIRCULATING-WATER PUMP HOUSE

THE TRANSMISSION LINES.

At the present time four sets of transmission lines —called Line A in Fig. 2 *ante*—are taken from the station. First of all there are two sets—six wires in all—running to distributing station A. Eventually

* No. I. appeared March 9th.

when the capacity of the power-plant is increased, four sets of lines are to be taken to this station. Then there is one set running to the State distributing station at Marquette, and another set to distributing station B, both shown as Line B in the map, Fig. 2 *ante*. Eventually there is also to be a transmission line to link up Quesnoy and Deulémont, Halluin and Armentières. In order to provide a standby in case of breakdown of the main generating units, there are step-down transformers reducing 45,000 volts to 10,500. They are connected to the bus-bars which two three-pole switches, and there is an oil-immersed circuit breaker in each alternator circuit. These bus-bars can be connected to the bus-bars just mentioned as being connected to the step-down transformers, the necessary switches, circuit breakers, meters, and reactances being provided. For the auxiliary services which are operated by three-phase current there are two 2000 k.V.A. transformers which reduce the 10,500 volts to 220 volts, the low tension current being delivered to bus-bars. The installation of a third 2000 k.V.A. transformer is contemplated.

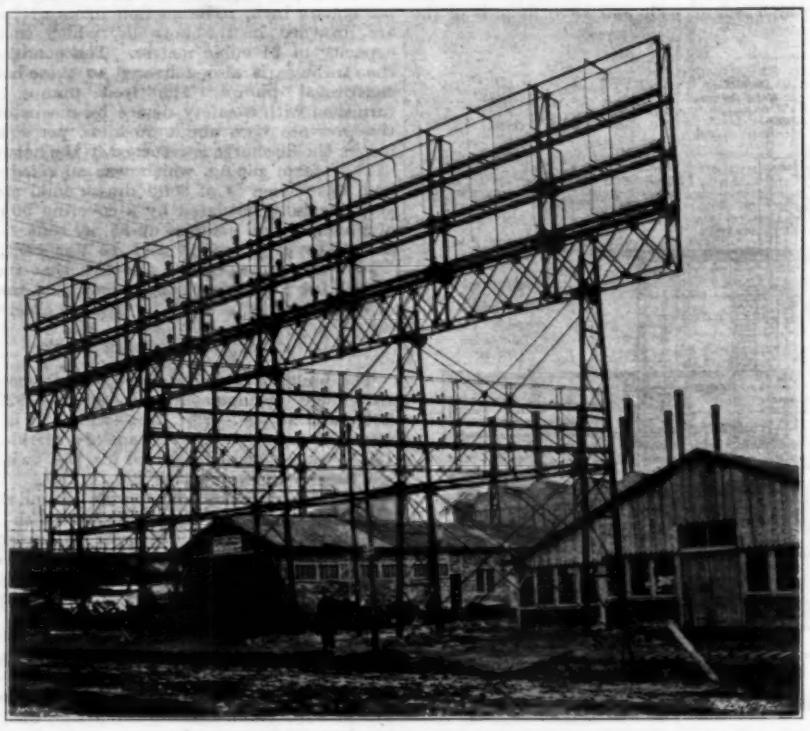


FIG. 15—SPECIAL CABLE TOWER NEAR POWER HOUSE

are ordinarily fed from the main generators and furnish current for pumping, lighting and other auxiliary services. By this means the station would not be entirely without current even if there were a total breakdown of the generating machinery, for current could be drawn from the Wasquehal generating station by way of the transmission lines. The transformers used for this purpose are of 5000 k.V.A. capacity and there are two of them. It is proposed, eventually, to instal a third of the same capacity. For supplying the Comines district itself there are at present three overhead 10,500-volt transmission circuits. Eventually, however, there are to be ten circuits in all, six of which are to be overhead and four under ground.

Bus-Bars for Auxiliary Services.

Current for the auxiliary services is provided by means of two sets of bus-bars which are connected to the terminals of the main generators by means of

For the auxiliaries worked by continuous current there are rotary converters which deliver current at a pressure of 220 volts. At the present time two 10,500 volt circuits—there will eventually be four—run to the circulating water pump house, in which there are two 1000 k.V.A.—10,500/220 volt—transformers, the circuits being furnished with the necessary switches and circuit breakers.

Circulating-water Pumping Plant.

At the pumping station—see Figs. 13 and 14—the water from the intake is led into two cisterns or sumps, which have a combined area of 118.5 square metres—or say 1276 square feet—the floors of which are arranged about 8ft. 8in. below the normal level of the river. The intake, which is of reinforced concrete and is 36ft. wide, has its sill about 10in. above that level. It has a dividing wall in the middle of its length, one side being in connection with one sump and the other with the other, sluices being provided so that either sump can be isolated at will. For preventing the passage of floating solids there is first of all a fixed grating in front of which there is detritus channel which can be cleared by means of vertical spindle pumps. Then there are gratings which can be lifted and cleaned by means of water jets. There is a steel platform over the intake which has rails on which can run the tackle for lifting these latter grids.

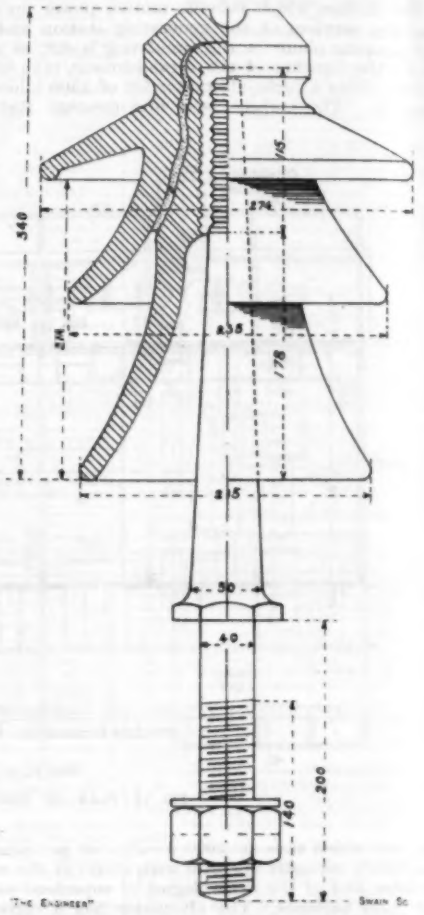


FIG. 16—INSULATOR FOR 45,000-VOLT LINE

The pumping station building is 91ft. 6in. long by 33ft. wide. The floor of the pump-room is very nearly at the same level as the normal level of the river, and about 10ft. 9in. below maximum flood level. In consequence of this fact all the building below 11ft. 9in. above normal river level is formed of a caisson of reinforced concrete carried on a block of plain concrete 15in. thick. The building itself is of reinforced concrete and it is provided with a 10 ton overhead travelling crane. There are four sets of motor-driven pumps. The latter are of the Rateau centrifugal type and the motors are three-phase 500 period, 220-volt machines of 450 horse-power running at 1415 revolutions per minute. Two pumps are sufficient to provide the requisite quantity of condensing

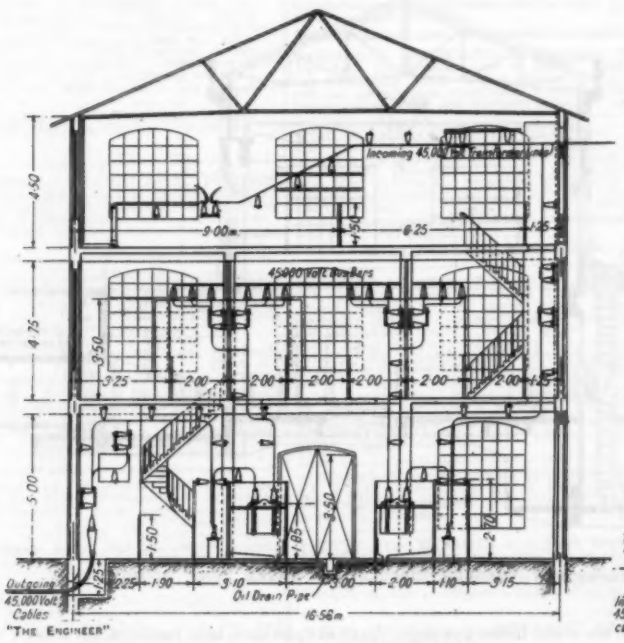


FIG. 17—SECTION THROUGH DISTRIBUTING STATION B.

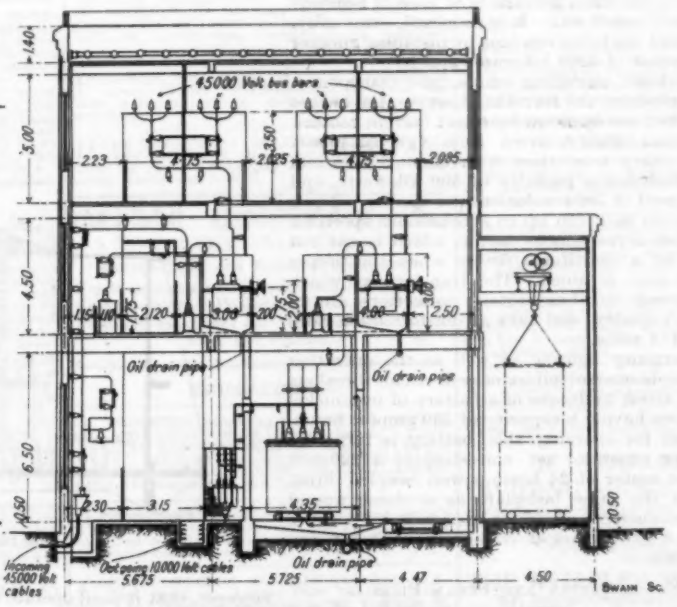


FIG. 18—SECTION THROUGH ROUBAIX SUB-STATION

water, but four are installed, so that one may act as standby, and one may be opened up for inspection and repair. The pumps discharge into a header from which two reinforced pipes are taken to the condensers in the basement of the engine-room. Upon each of these pipes there are branches leading to each of the three condensers. Normally 2000 litres of water per second—say 26,400 gallons—per minute, are required for each condenser, and the maximum head against which the circulating pumps have to work is 12 m.—or, say, 39ft. 4in. The pumps are primed by means of two motor-driven vacuum pumps. When the capacity of the station is doubled, and the Lys will not be able always to supply sufficient water to deal with all the steam, it is purposed to construct a series of cooling towers, with a capacity sufficient to cope with the water required by two condensers. For the purpose of dealing with this additional water the pumping-station will have to be increased in size, for it will eventually have to contain eight motor-driven pumps, each capable of dealing with 2 cubic metres—say 440 gallons—of water per second, against a head of 12 m. The two 1000 k.V.A. 10,500/220-volt transformers which supply the motors with current are, with the necessary switching equipment, housed at one end of the pumping-station building.

The Distribution and Sub-Stations.

The various transmission lines in the neighbourhood are shown on the map,—Fig. 2 *ante*. From the Comines station 45,000-volt lines, some 14 kiloms. long, run to the distribution station A from which one 45,000-volt underground line is taken to a sub-station at Roubaix and another to a sub-station at Tourcoing. The distribution station A is also connected with the generating station at Wasquehal by overhead cables. There is thus direct communication between the two generating stations. The Lille district is served by 45,000-volt transmission lines, about 12 kiloms. long, running from the Comines power-house to the distributing station B, which is directly connected by underground cables with Madelaine sub-station. Overhead lines also run to the State sub-station near Marquette. The high-tension transmission lines as they leave the Comines station are supported on specially designed lattice-work steel towers—see Fig. 15—which are designed for three horizontal rows of sixteen conductors each. The conductors are copper cables each made up of nineteen strands of 2.65 mm. wire which give a total cross section of 105 square millimetres, or about 0.16 square inches. Some 760 yards from the generating station the various lines diverge to their separate destinations and the cables are then carried on lattice work towers, some for six conductors and some for twelve. The insulators used for the 45,000-volt circuits are illustrated in Fig. 16. They were tested with 140,000 volts before being put into service. There are, in addition to the 45,000-volt lines, networks of 10,500-volt lines.

The distribution station A is a reinforced concrete building 26 m.—85ft. 4in.—long, by 54ft. long and 54ft. high. On the ground floor are the circuit breakers for the incoming and outgoing 45,000-volt lines, the switching arrangements, the openings to the ducts for the underground cables, and a battery-room. On the first floor are the bus-bars, and on the second floor the lightning arresters, &c. Four sets of 45,000-volt transmission lines, each designed for a capacity of 15,000 kilowatts, are led into the building. Each circuit is protected by means of horned lightning arresters and liquid resistances. The underground cable line to Tourcoing measures 2350 m. in length, and is composed of four insulated cables, each of 150 square millimetres cross section, of which one acts as reserve. The underground line to Roubaix has a length of 3½ kiloms., and its four cables each have a cross section of 340 square millimetres. A cross section of the station is given in Fig. 18. The distributing station B—a section of which is given in Fig. 17—is similar in general arrangement to station A, and need not therefore be illustrated. It is a steel-framed building filled in with bricks. At present there is only underground cable connection between it and the Madelaine sub-station, the distance between the two being 1650 m., and the four cables used each having a cross section of 150 square millimetres. The cables, are enclosed in concrete troughs. All the cables before being laid were subjected to a laboratory test with 80,000 volts for five minutes.

In the sub-station at Roubaix,—see Fig. 18—which measures 23 m. long by 20 m. wide and 18.15 m. high, there are on the ground floor four three-phase 5000 k.V.A. 45,000/10,500 volt transformers, each in a separate cell. The first floor is reserved for the high-tension switches, while on the second floor are the distribution bus-bars. The sub-station at Turcoing is a smaller building which only contains two 5000 k.V.A. transformers. The Madelaine sub-station likewise contains only two transformers of similar capacity. All the sub-stations have been designed with a view to their being subsequently enlarged.

The whole of the work of building and equipping the power station, the distribution stations, and the sub-stations as well as the running of the overhead and underground transmission lines was carried out for the Société L'Energie Electrique du Nord de la France by La Société Générale D'Entreprises of 56, Rue du Faubourg-Saint-Honoré, Paris.

Condensing and Utilisation of Exhaust Steam in Locomotives.

No. I.

The utilisation of the heat in exhaust steam to increase the thermal efficiency of the locomotive engine may be considered under two heads :—

A.—Locomotives which condense a comparatively small volume of the exhaust, generally for the purpose of feed-water heating.

B.—Locomotives which condense the whole of the exhaust in order to expand the steam down to the lowest practical possible pressure below that of the atmosphere.

There are also engines, similar in arrangement to some of those under A, in which condensing is used in order to prevent the emission of steam and smoke in tunnels. In this type increased thermal efficiency is of secondary importance.

A.—Condensation for Feed Heating.

The utilisation of exhaust steam for feed water heating purposes has had many applications since the earliest days of locomotives, and a few of the more interesting examples will be described below. The earliest locomotive feed heater was probably that of Trevithick, which consisted of a chamber surrounding the exhaust pipe, but for the purpose before us we may take that of Timothy Hackworth, in the Stockton and Darlington engine Royal George of 1827 as originating the type. As described by D. K. Clark ("Railway Machinery, 1855), "a cistern was attached to the smoke-box, into which the waste steam could be turned, for heating the feed-water; here also the short stroke pump was first employed, being driven by the eccentrics." The published illustrations of the Royal George do not show the details of this arrangement.

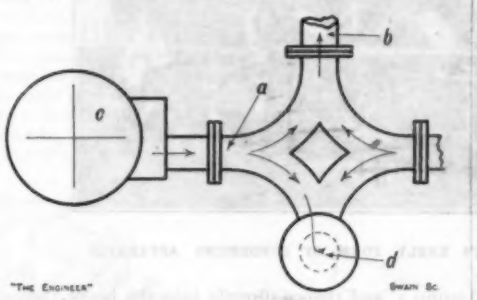


FIG. 1—KIRCHWEGER'S ARRANGEMENT

Apart from some American designs, the condensation of exhaust steam for feed-water heating in locomotives remained dormant in Europe until about 1851, when Kirchweger, then chief locomotive engineer of the Hanoverian State Railways, invented an apparatus which for nearly twenty years was extensively applied in Germany and other continental countries. Fig. 1 is a diagram of the arrangement at the cylinder end. The exhaust from the cylinder *c* passed into a special pipe *a*, the upper branch of which led to the blast pipe *b*, and the lower branch to a longitudinal pipe *d*, through which the steam could be led to the tender. In the top of the blast pipe, below the orifice, a butterfly valve—see Fig. 2—was inserted, by means of which the driver could control the blast or shut it off altogether. In the latter case the whole of the exhaust passed through the pipe *d* to the tender. This pipe, also shown in Fig. 2, was provided with a flexible coupling at *e*, and a cock *f*, by means of which the driver could regulate the supply of steam to the tender. A non-return valve *h* prevented the water from passing back and flooding the cylinders. The steam pipe terminated in a perforated end *i* at the bottom of the tender. Water of condensation, which collected in the pipe, could be blown out through the cock *g*. The water pipe from the tender to the feed pump *k* was provided at *l* with a flexible coupling, and the pump had to be fitted with an air vessel on the suction pipe below the suction valve. The addition of the air vessel, which had a capacity of 1½ to 2 times the displacement of the pump plunger, enabled boiling water to be delivered to the boiler without difficulty. The tender was provided at the top with a vertical outlet pipe, from which excess of steam could escape to the atmosphere.

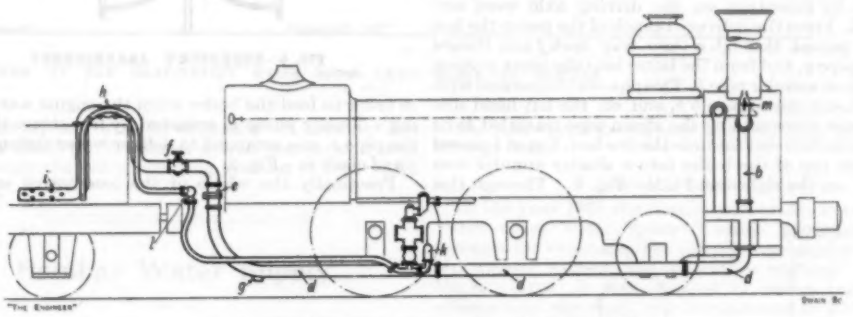


FIG. 2—KIRCHWEGER'S FEED HEATING SYSTEM, 1851

Trials of the system were stated to have shown a saving of 13.8 per cent. of coke and of 21.2 per cent. of water, and for an equal number of train axles 15.5 per cent. coke and 23 per cent. of water.

The majority of the Hanoverian State engines were fitted with Kirchweger's apparatus, and injectors were not used until about ten years after their invention. Other German and continental railways had previously discarded it in favour of injectors, on account of the complications involved.

By far the best known of the early systems of condensing part of the exhaust steam for feed water heating were those invented by Mr. Joseph Beattie, and used for about twenty-five years on the London and South-Western Railway. In Beattie's earlier apparatus, which was first applied in 1854, a combined jet and surface condenser was used. A vertical rectangular vessel was fixed on the smoke-box in front of the chimney. This chest was divided into two portions by a vertical partition, one of which formed the jet condenser and the other the heater, the latter being provided with vertical tubes. The exhaust steam entered the vessel on the tubular heater side, surrounded the tubes, and then passed over through a chamber in the top to the other side of the partition, where it met a jet of cold water delivered from the tender by means of the cold water pump. The pumps were driven either from the crossheads or by means of excentrics on the driving axle. The heated water left the jet condenser in the direction of the tender, and when the feed to the boiler was entirely shut off, the whole of the water returned to the tender for warming purposes. The pipe conveying the water passed above the footplate, and at this point was fitted with a T piece and regulating cock. When this cock was opened by the driver a portion of the hot water, the amount of which could be regulated, passed into a branch pipe connected to the T piece, and thence to the hot water pump. From this pump it was again delivered into the heating vessel, on this occasion into the tubular heater side, where it took up further heat from the exhaust steam and then passed into the boiler.

There appear to have been defects in this early system. The tubular side of the condenser, being situated between the hot water pump and the boiler, was under pressure when the apparatus was in use, and was apparently difficult to clean out and free from deposit. In a modified design the tubular condenser was placed within the smokebox, though the exhaust steam from the blast pipe was relied upon to provide the heat. This was the form described by D. K. Clark, who referred to the tubular condenser as a "surcharging chamber." An engine showing one of the early forms of Beattie's apparatus is illustrated in Fig. 3.

At the time when Beattie's early apparatus was being installed in this country, another German locomotive superintendent, Rohrbeck, of the Eastern Railway of Prussia, brought out an arrangement which was simpler than that of Kirchweger, though similar in principle. It consisted of a copper pipe 3½in. in diameter leading from the top of the blast pipe to the bottom of the tender, into which the exhaust steam was discharged through a series of holes in the pipe. Unlike Kirchweger's apparatus, in which the steam had to descend to a level below the cylinders, Rohrbeck arranged for the steam to rise from the blast pipe in an upward direction in order to reduce the resistance to flow. Thence the pipe was taken in a horizontal direction along the outside of the boiler towards the cab. In the cab there was a vertical brass pipe with an arrangement for vertical movement, the horizontal and vertical pipes being connected through a knee piece by means of a flexible rubber hose.

The interesting portion of Rohrbeck's apparatus lay in the blast pipe connections, which are shown diagrammatically in Fig. 4. The blast pipe cap was arranged with an internal cone which could be raised or lowered from the footplate, and the branch pipe from the cap was fitted with a butterfly valve. When the apparatus was in action for the purpose of feed heating, the internal cone was raised and reduced the blast pipe orifice. At the same time the butterfly valve in the branch pipe was opened, and a portion of the exhaust was thus diverted to the tender.

A saving of 17 per cent. of coke and of 23½ per cent. of water was claimed for the system during the trial runs. It is doubtful whether these results would be attained in regular service, as the valves and their actuating gear would be liable to clog owing to their position in the smoke-box, unless constant attention were paid to them. Much also would depend upon the judgment and skill of the driver.

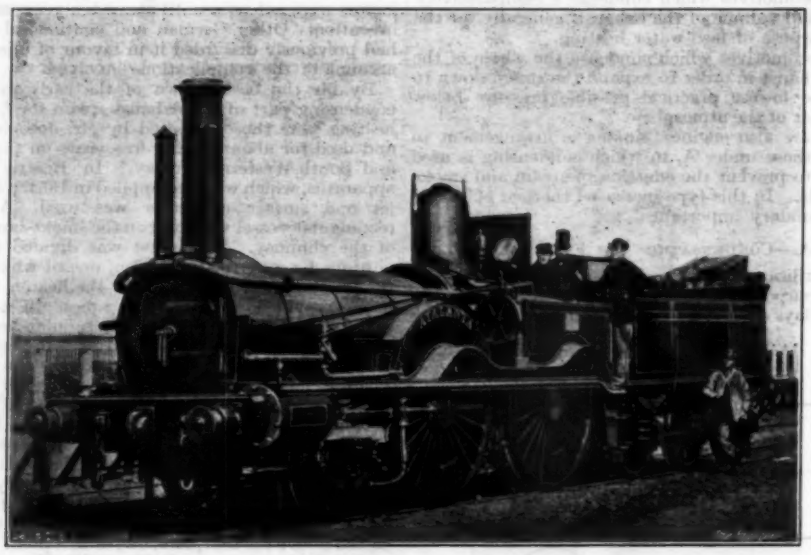


FIG. 3—L. AND S.W. ENGINE WITH BEATTIE'S EARLY FORM OF CONDENSING APPARATUS

In this country, Joseph Beattie continued to improve his condensing system for feed water heating, which attained the final form shown in Figs. 5 and 6.

This design does not appear to have been fully and clearly described in any technical journal, and therefore some account of it may be of interest. Beattie's exhaust pipes for outside cylinder engines were similar in form to those of Rohrbeck, that is, each cylinder had an independent exhaust pipe which followed the contour of the smoke-box, and the two united immediately underneath the blast pipe cap. Each exhaust pipe had a branch near the top, which issued from the smoke-box at *a* and *a'*.

On the left-hand side of the boiler—Fig. 5—the exhaust steam from *a* passed through the copper pipe *b b* direct to the tender to heat the water in the latter. On the right-hand side—Fig. 6—the steam issued from *a'* through the pipe *b' b'* to a chamber or jet condenser *c* which was placed underneath the footplate. Referring again to Fig. 5 of the left-hand side, the warmed water from the tender entered the jet condenser *c* in the direction of the arrow, and underwent the second stage of heating. The inlet to this condenser was controlled by the cock *t*, and its outlet by the valve *n*. From the latter the water passed through the pipe *d* to the crosshead pump *e*, though in many outside cylinder engines short-stroke pumps driven by excentrics on the driving axle were employed. From the delivery branch of the pump the hot water passed through a three-way cock *f* and thence to the pipe *g*, and from the latter into the outer portion of the iron annular pipe *h*. This pipe was concentric with the exhaust steam pipe *b b*, and on the left-hand side the water surrrounding the steam pipe travelled from the smoke-box end towards the fire-box, but at *i* passed over the top of the boiler into a similar annular iron pipe *h'* on the right-hand side—Fig. 6. Through this pipe it travelled in the opposite direction from the fire-box to the smoke-box end, where it entered the branch pipe *k*, and was delivered to the boiler through the clack-box *l'*. The annular pipes *h* and *h'* constituted an elementary form of surface condenser, in which the water underwent a third stage of heating by the exhaust as the latter issued from the blast pipe at its maximum temperature. The apparatus was very complicated and entailed various accessory and by-pass devices. If a defect showed itself in the pipes *g*, *h*, *h'*, &c., the three-way cock *f*—Fig. 5—was operated, and the water from pump *e* on the left-hand side was delivered directly to the boiler through the clack-box *l*. Similarly, on the right-hand side—Fig. 6—the water could pass from the condenser through pipe *d'* to the pump *e'* and thence directly into the boiler through the clack *m'*. By means of the valves or cocks *u* and *u'* the driver could cut off the exhaust steam entirely either from the tender or the condenser *c*. Finally,

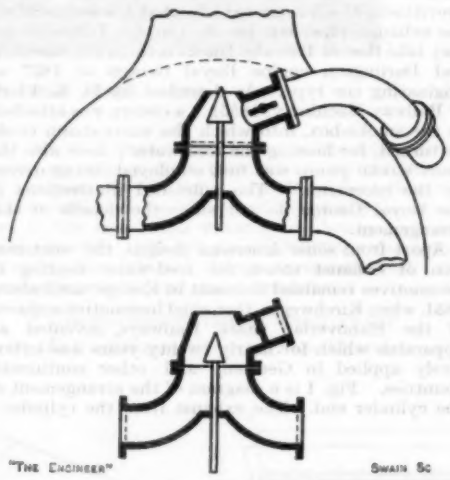


FIG. 4—ROHRBECK'S ARRANGEMENT

in order to feed the boiler when the engine was standing a donkey pump *p*, actuated by live steam through the pipe *s*, was arranged to deliver water through pipe *r* and clack *m*—Fig. 5.

Practically the whole of the locomotive stock of the London and South-Western Railway in 1878—about 380 engines in all—was fitted with one or other of the forms of Beattie's condensing feed-water heating apparatus, but after the arrival of the late Mr. W. Adams as chief locomotive engineer, it was gradually discarded, owing to the complications and cost of maintenance. Moreover, the old form of donkey pump for feeding when the engine was standing consumed a considerable amount of live steam.

Starting with water at 60 deg. to 70 deg. Fah., the temperature in the tender would soon rise to about 80 deg. to 85 deg. The delivery to the boiler shortly after the start would reach 120 deg. to 130 deg. Fah., which increased to 160 deg.—170 deg. after running about 20 miles. The tenders had a capacity of 1950 gallons when full, and as the water level in them decreased, the temperature rose to about 100 deg. and the delivery to the boiler to about 190 deg.—200 deg. in ordinary service, though towards the end of a long run it would often attain 210 deg. The saving in fuel was estimated to be about 13½ per cent., an amount of great importance on a railway on which the cost of coal was great.

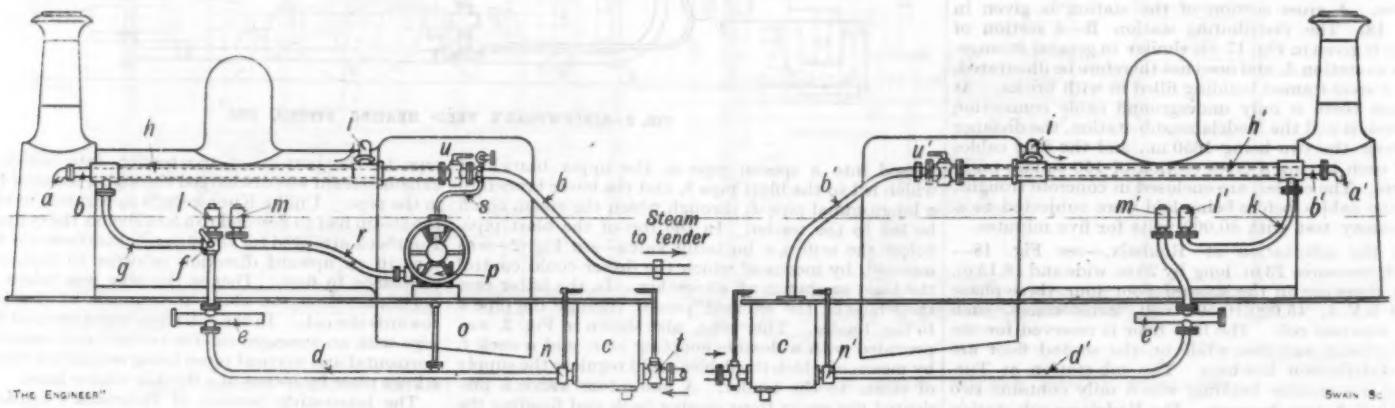
It was considered by some engineers that the system of feed-heating by condensing the whole of the available proportion of the exhaust steam in the tender only was not good practice, for the reason that much heat was lost from the tender by radiation, and that there was a further loss during delivery to the boiler. Beattie appears to have realised this, since the warming of the water in the tender up to about 100 deg. was only the first stage in his system. In direct tender-warming systems the maximum temperatures attained in special cases appear to have been 180 deg. —195 deg., and the average temperatures in the neighbourhood of 160 deg.

Condensing the exhaust in surface condensers, through which the feed water passed on its way from the tender to the boiler, was at one time extensively tried in Germany, where a system by Ehrhardt had several applications. The hot water of condensation from the condenser was delivered to the tender, though it was claimed that much of the oil in the exhaust steam was trapped in the body of the condenser, which acted as a partial steam separator. No temperature details are known to the writer. The arrangement was, however, too expensive and complicated, and was afterwards abandoned.

Stroudley, on the London, Brighton and South Coast Railway, turned part of the exhaust steam from the cylinders into the tender.* The pipe, 3in. in diameter, passed through the water in the latter and then rose vertically into a closed funnel, into the top of which the steam found an outlet at a height of about 1ft. 3in. above the highest water level. By this means water was prevented from passing back into the cylinders. The steam was deflected downwards on to the surface of the water in the tender. The temperature of the water averaged about 150 deg., but at times rose to over 190 deg. This system was also used for tank engines. In them a by-pass valve was arranged, which the driver could close when the pump delivered the water to the boiler. When the valve was open the water was discharged into the upper part of the tank, condensing the steam.

The above arrangement, though the principle was similar to that of Kirchweger, was much the simplest of the tender condensing arrangements, and quite as efficient as the more complicated systems which preceded it. The feed temperature in the case of Beattie's apparatus was somewhat higher, but was obtained at the cost of expensive complications.

Mr. D. Drummond heated the feed water in the tenders by means of a tubular heater of the surface condensing type placed in a well underneath the body of the tender, and no direct contact took place between the exhaust steam and the water. A temperature of 180 deg. is stated to have been obtained in the tender by this system. Direct driven steam pumps were used for delivery to the boiler instead of the earlier type of crosshead or excentric driven pumps employed by Beattie, Stroudley, and others. Mr. F. H. Trevithick, on the Egyptian State Railways, also used direct steam driven pumps, which have several great advantages. But a description of all the feed-water heating systems is beyond the scope of this article, in which attention has been drawn only to some of the more interesting of those systems formerly in use which relied exclusively, or almost so, upon the



FIGS. 5 AND 6—BEATTIE'S FINAL FORM OF CONDENSING SYSTEM FOR FEED WATER HEATING

*Stroudley did not claim this device for himself, but stated that the system was in use during Mr. J. Craven's superintendency.

condensation of part of the exhaust steam. Modern condensing feed heating systems were described in the paper read last year by Professor Ed. Sauvage before the Institution of Mechanical Engineers.

General Considerations.

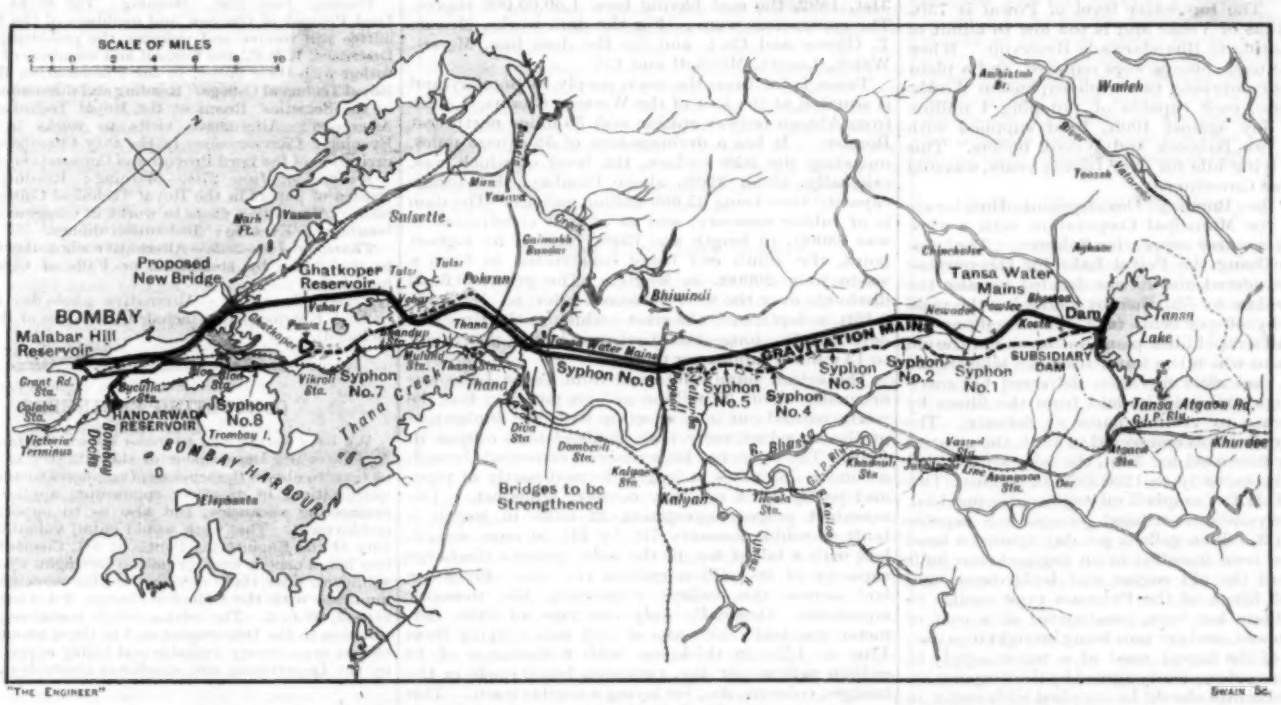
The quantity of exhaust steam which may be condensed for feed water heating depends upon the work which the engine is doing, the dimensions and proportions of the boiler and cylinders, and, if the system is non-automatic, upon the skill and care of the driver. The necessary draught required in the smoke-box has to be maintained, and only the surplus steam above the constantly varying quantity required for this can be condensed if the working of the engine is not to suffer. The amount of steam required to produce the necessary blast is, however, reduced, since the heat in that portion of the steam passed through the condensing system is utilised in raising the temperature of the feed, and therefore diminishes the work to be done within the boiler itself.

About 15 per cent. of the total exhaust was estimated in the case of some of the old systems. Stroudley, as a result of test, stated that 20 per cent. was returned to the tender, and in Messrs. Trevithick and Cowan's paper (Institution of Mechanical Engineers, 1913), it was stated that the volume of steam driven through the blast pipe orifice was diminished by over 12 per cent. It appears that about 15 per cent. may be taken as a fair average. The advantage in reducing the loss of unburnt fuel by this reduction in the weight of steam exhausted through the blast pipe was clearly set forth in the paper by Trevithick and Cowan, mentioned above.

To what extent the back pressure on the pistons is reduced is by no means certain, and depends to a large extent upon the length and dimensions of the systems of pipes and condensers. In some of the early German systems the back pressure is stated to have been increased, chiefly, no doubt, owing to the valves, cocks, and bends in the long exhaust steam pipes system. In the case of the older systems of condensing feed heating arrangements used in this country no comparative indicator diagrams, taken when the engines were working with and without the apparatus in action, are known to be available, and those taken when the system was in operation do not appear to show less back pressure than an ordinary well-designed locomotive without feed heating. Theoretically, the condensing of 15 to 20 per cent. of the exhaust should show a reduction, but this appears to have been offset by the resistance to the free passage of the steam in the long pipes to the tender. In modern systems, such as Trevithick's, in which the condenser heaters are placed near the cylinders, it is possible that some reduction of back pressure actually occurs, dependent chiefly on the form of condenser heating used. This point is referred to in Trevithick and Cowan's paper—"Proc.," Inst. Mech. Eng., March, 1913, page 379—in which it is stated that the virtual enlargement of the blast pipe top, when about 15 per cent. less steam is passed through it, with the resultant reduction of back pressure, greatly benefits the cylinders. Recent tests made on the Belgian State Railways with a heavy 2-8-0 goods engine fitted with the Caille Potonié heating system, certainly show a definite reduction of back pressure in the blast pipe throughout the journeys.

A great advantage, apart from fuel economy, is gained in water economy, since a considerable percentage of the exhaust is returned to the boiler, either directly or through the tender. Stroudley pointed out that this fact was a specially valuable feature in the case of tank engines which carried a limited water supply. But in the case of tank engines, in which the exhaust is diverted into the tanks, the limited water capacity prevents the full utilisation of the available exhaust steam, since the water becomes so hot that further condensation is impossible, and much of the steam is wasted by being allowed to escape to the atmosphere.

A defect, frequently mentioned in the case of the older installations, was that when the engine came to a stand, and the feed was necessary to prevent blowing off at the safety valves, the apparatus automatically ceased to act. To obviate this defect, Beattie added a direct live-steam driven pump, and appears to have been the first engineer to do this. Had he gone a step further and used suitable direct steam pumps for feeding when running, it is possible that condensing feed water heating systems would not have died out as they did for a long period. But it is doubtful whether a really efficient live steam-driven pump existed at that time. The old crosshead or excentric driven pumps gave a considerable amount of trouble, especially with hot water, and air vessels had to be provided. Stroudley, in his fast running engines, provided a small cock from the Westinghouse air reservoir, so that when the water was so hot that no vacuum could be formed, a little air was forced in to ease the action of the pump. But the chief cause of trouble with these pumps was caused by the hydraulic ram action due to the inertia of the water at high speeds, which caused such high internal pressures that pumps and pipes frequently burst. It resulted that the injector with its simplicity of working and upkeep killed the crosshead driven pumps, and with them went the old condensing systems of feed water heating.



MAP SHOWING THE ROUTE TAKEN BY THE GRAVITATION MAINS FROM LAKE TANSA TO BOMBAY

Bombay Water Supply.

No. 1.

FOR use during an inspection by the Corporation of Bombay of the new works which are being carried out to increase the water supply from Lake Tansa, a brochure giving a history of the water undertaking of the city from the earliest times was prepared. From it the following information has been abstracted.

Vehar Works.

The Vehar Waterworks were originated by Captain I. H. G. Crawford, of the Bombay Engineers. His plans were afterwards worked out by Lieut. A. DeLisle, of the same corps, and Mr. H. Conybeare. The work was begun in 1856 and finished in March, 1860, and was carried out at a cost of 65 lakhs of rupees. Mr. Walker was engineer-in-charge and Messrs. Brey Son and Champney, of Leeds, the contractors. Vehar Lake covers an area of 1800 acres, and has, exclusive of the lake area, a gathering ground of 2550 acres. It is formed by damming three valleys with earth embankments. The dams are of the usual section, having an exterior slope of 2½ to 1 and an interior slope of 3 to 1. The main dam—including the waste weir—is 1130ft. in length, with a width at the top of 24ft., and is 85ft. high at the highest point. At the time of construction it was one of the highest earth dams in the world. The other two are considerably smaller. The surfaces of all the dams are pitched with rough rubble to prevent erosion. A waste weir, 350ft. long, is constructed at the north end of the main dam for carrying off the flood water. The top water level is 165ft. above the level of the roads in the Fort, Bombay, and the average depth the surface of the water sinks yearly is about 12ft. The total capacity of the lake is 9120 million gallons.

The water from Vehar Lake is drawn from an ornamental masonry tower built in the lake near the south end of the main dam, and fitted with regulating sluices built in at various levels. It is conveyed thence through a 42in. diameter cast iron pipe laid in a tunnel driven through the adjoining hill. After passing through the tunnel the pipe is enlarged to 48in. diameter and continues southwards *viâ* Saki as far as Kurla, the pipes for the first two miles being of riveted steel plates, the remainder of cast iron. After leaving Kurla the main is reduced to 32in. in diameter and is laid alongside the Tansa mains to Matunga. From Vehar to Matunga this main is laid above ground and thence it passes underground through Vincent, Suparibag, Curry, DeLisle and Nesbit roads, delivering its daily supply of 6 million gallons into Bhandarwada Reservoir, where it is stored and distributed to the city. A 24in. diameter cast iron main branches from the 48in. main just north of Kurla and follows the old Bombay–Agra road southward to the northern part of Bombay, where its supply of 4 million gallons per day is distributed through smaller service pipes to the consumers. The whole length of this main is laid underground. The average rainfall at Vehar is 81in.—maximum 129in., minimum 35in. The temperature of the lake varies throughout the year from 78 deg. to 92 deg. Fah.

Tulsi Works.

In the year 1868 the necessity of another source of water other than Vehar became apparent, and schemes for increasing the supply were submitted by Mr. Russel Aitken, the executive engineer to the Municipality. It was decided to adopt the Tulsi scheme and the work was commenced in 1872 and completed in 1879. These works consisted of forming Tulsi Lake, laying a pipe from Tulsi to Bombay, constructing Malabar Hill Reservoir, and laying distributing pipes to the Fort and Colaba. The works were carried out under the supervision of Mr. Rienzi Walton, at a cost of 40 lakhs of rupees. Tulsi Lake covers an area of 330 acres, with a catchment area of 1714 acres, and is formed by the construction of a masonry dam across the Tulsi Nala and a second dam with a waste weir 142ft. long built on a small ridge of hills between Vehar and Tulsi. All the surplus flood water from Tulsi flows into Vehar Lake. The main dam is 1350ft. long and 85ft. high at its highest point.

The lake impounds 2294 million gallons of water, the top level of which is 350ft. above Bombay. A masonry collecting tower is built in the lake on the south side, and like the one at Vehar is also fitted with sluices, arranged to draw off water at various levels, so that water of the best character may be selected for consumption. From this tower a cast iron main, 24in. diameter, is laid along the western side of Vehar Lake, through Marol to Bandra, where it crosses the Creek by a bridge adjoining the Railway Bridge and skirts the west side of the B.B. and C.I. Railway to the Mahaluxmi Race Course, whence it continues

through Clerke, Pedder and Gibbs roads to Malabar Hill Reservoir. The supply through this main is 4 million gallons per day. The average annual rainfall at Tulsi is 104in. (maximum 145in., minimum 45in.). The temperature of the water in the lake is practically the same as at Vehar Lake.

At the present time filters are being installed below the main dam on the southern side of the lake. They are of the Paterson Rapid Filter type and comprise seven units, each of 20ft. by 18ft., capable of filtering 4 million gallons per day. The raw water from the lake will be received in two coagulating tanks built adjacent to the filters and a saturated solution of alumina sulphate added to the water as it enters these tanks in proportion to the quantity of water supplied. After a period of sedimentation the water passes through the filters and into the 24in. diameter main for distribution to the city. Provision is made for chlorinating the water as it leaves the filters should the necessity for this arise. The whole plant is mechanically operated and the building electrically lighted.

Powai (or Pawa) Works.

The Powai works were designed and carried out in 1890 at a cost of 6 lakhs of rupees by Mr. S. Tomlinson, A.M. Inst. C.E., water engineer to the Municipality, as an emergency reservoir to mitigate an anticipated water famine in 1891 before Tansa water was introduced. The works as originally constructed consisted of a lake 365 acres in area about one mile south of Vehar Lake, formed by building a masonry dam across the valley, thereby impounding water from a catchment area of 1700 acres. The dam is 650ft. in length and was 25ft. high at the highest point and forms its own waste weir, the waste weir being 580ft. long. The top water level of Powai is 75ft. lower than that of Vehar and is too low to admit of water gravitating to Bhandarwada Reservoir. When this lake was used pumps were required, and a plant was installed comprising two triple-expansion Worthington engines, each capable of pumping 4 million gallons per day against 100ft. head, supplied with steam from two Babcock and Wilcox boilers. This plant, after lying idle for over twenty years, was sold to the Madras Government.

In 1919 the Bombay Development Directorate approached the Municipal Corporation with a view to obtaining a water supply for Salsette. The possibility of utilising the Powai Lake for this purpose was then considered, and it was decided to raise the height of the dam by 5ft., thereby increasing the yield of the lake by 50 per cent. to 3 million gallons per day, to install a rapid filter plant on the site of the old Vehar filters to which the water from the lake should be pumped, and after filtration delivered by gravitation through mains to be laid from the filters by the Directorate to various parts of Salsette. The raising of the dam was completed in 1921, the greatest height being increased to 30ft., the lake area to 465 acres, and the capacity to 1200 million gallons. Two sets of 100 B.H.P. Campbell oil engines driving 12in. diameter Gwynne's centrifugal pumps, each capable of delivering 3 million gallons per day against a head of 60ft., have been installed in an engine-house built on the site of the old engine and boiler-house and a range of 5 filters of the Paterson type similar to the Tulsi filters has been constructed at a cost of 5 lakhs of rupees, and are now being brought into use; but in view of the urgent need of a water supply to Salsette it was subsequently agreed by the Corporation that the Directorate should be supplied with water in bulk from either the Vehar and Tulsi mains to the limit of 2.7 million gallons per day, and that the Powai scheme be utilised to supplement the Vehar supply. The rainfall at Powai is 122in. maximum and 33in. minimum.

Malabar Hill Works.

The works at Malabar Hill consists of two reservoirs, an electrically-driven pumping plant delivering into an overhead tank, and a control house for distributing the water to the city. The large reservoir, 530ft. long by 307ft. wide by 20ft. deep, with a capacity of 18 million gallons, is covered over with a concrete roof. The other is of irregular shape, 700ft. long of varying width, 17ft. 9in. deep, covered with arches, and having a capacity of 11 million gallons. A garden named the "Sir Pherozeshah Mehta Garden," covering about 8 acres, is formed over the two reservoirs, and is open to the public for use as a pleasure-ground. The pumping plant consists of two electrically-driven centrifugal pumps, each capable of discharging 40,000 gallons per hour into a cast iron tank of 68,000 gallons capacity, 70ft. above them. The tank is at the top of the masonry tower built at the south-west corner of the large reservoir and serves to supply the residences on the top of Malabar and Cumballa hills. The old and the new Tansa mains discharge into these reservoirs. The supply pipes from these works are two 24in. diameter mains to the Girgaum, Bhuleshwar and Dhobi Talao districts, a 24in. diameter main to the Fort and Colaba districts, a 24in. diameter branch main to the Sandhurst Road localities, and a 12in. diameter main to Cumballa Hill and Ridge-road.

Bhandarwada Works.

These works consist of two reservoirs and the usual distributing works. They were started in 1880 in consequence of the numerous complaints of defective supply, and were constructed in order to restore continuous supply from Vehar Lake and give a better supply for fire-extinguishing purposes. They were brought into use in 1884; the cost of construction amounting to 18 lakhs of rupees. The larger reservoir has an area of 73,000 square feet by 15ft. deep with a capacity of over 6 million gallons, the other an area of 37,000 square feet by 20ft. deep with a capacity of over 5 million gallons. Both reservoirs are covered over. One of them is roofed over with brick arches, the upper surface of which is earthed over and a garden laid out. This garden, named the Sir John Hay Grant Reservoir Garden, like the one at Malabar Hill Reservoir, is open to the public for use as a pleasure-ground. Formerly there were also nine filters of the slow sand gravity type having a total filtering area of 15,630 square yards. These are now being substituted by filters of a more efficient type at Powai, and the old filters are about to be converted into reservoir accommodation, thus increasing the total storage at this station to about 20 million gallons. The supplies from the 48in. Vehar main and the old and the new Tansa mains are received in the works.

Tansa Works.

The Tansa waterworks, estimated to supply the city of Bombay with 21 million gallons of water per diem, through an aqueduct 55 miles in length, from a lake 6 square miles in area, were first designed and reported upon by Major Hector Tulloch, R.E., executive engineer of the Municipality, 1872. They were undertaken in pursuance of a resolution passed by the Corporation on August 10th, 1883, Mr. W. J. B. Clerke (now C.I.E.) being the engineer, and were opened by H.E. the Marquis of Lansdowne, on March 31st, 1892, the cost having been 1,50,00,000 rupees. The contractors were:—For the dam works, Messrs. T. Glover and Co.; and for the duct line, Messrs. Walsh, Lovett, Mitchell and Co.

Tansa Lake forms the main supply to Bombay and is situated at the foot of the Western Ghauts, 4 miles from Atgaon railway station and 55 miles north-east Bombay. It has a drainage area of 53 square miles, including the lake surface, the level of which was, originally, about 320ft. above Bombay, the storage capacity then being 35,600 million gallons. The dam is of rubble masonry, and as at first constructed it was 9800ft. in length and 135ft. high at its highest point, the south end being constructed to form a waste weir 2000ft. in length. The greatest flood discharge over the weir measured prior to 1892 was 3.15ft. in depth over the crest—which at the time was only 1650ft. long—the discharge being equivalent to 13 million gallons per minute.

The actual supply obtained from Tansa Lake was originally about 21 million gallons per day, but the works carried out in connection with the duplication of the aqueduct more than doubled that output in 1916. The water has hitherto been conveyed through a conduit, 55 miles in length, formed partly of pipes and partly by a masonry covered aqueduct. The aqueduct proper, aggregating 22 miles in length, is built of rubble masonry 7ft. by 6ft. in cross section laid with a fall of 6in. to the mile, giving a discharge capacity of 40 million gallons per day. Pipes are laid across the valleys connecting the masonry aqueducts. Originally only one pipe of 48in. diameter was laid; this was of cast iron varying from 1¼in. to 1⅜in. in thickness, with a discharge of 18 million gallons per day, provision being made in the bridges, culverts, &c., for laying a similar main. This provision was utilised in 1915 when the "Tansa Duplication Works" were commenced and an additional main laid. The duplicate main is of steel for the first 19 miles, 50in. diameter by ⅜in. thick. It is constructed of "lockbar" pipes each 28ft. in length joined together with "Kimberley" steel collars jointed with lead; the remaining length being of cast iron, 48in. diameter, similar to the original main. The original main branches into three mains on reaching the city. Two branches, one of 27in. diameter and one of 22in. diameter, pass through Arthur-road to Grant-road and thence to Malabar Hill Reservoir; the other, of 18in., is laid through Kalachouki-road to Bhandarwada Reservoir. The new 48in. main is divided at Victoria Gardens into two branches each of 36in. diameter. One passes through Victoria Gardens and Mount road to Bhandarwada Reservoir, and the other crosses the G.I.P. Railway at Byculla and passes through the Agripada Estate to Malabar Hill Reservoir *viâ* Lamington-road, Harvey-road and the Hanging Gardens. The rate at which water is delivered into the reservoirs by these two 48in. mains is almost constant in each case, being about 750,000 gallons per hour.

The following inscription which appears upon a memorial sun-dial erected over the south end of the dam describes the Tansa Duplication Works:—The extension of the Tansa waterworks by the raising of the dam from 405ft. to 414.58ft. above the Town Hall Datum at Bombay, and by the duplication of the Tansa Pipe Line was begun in the year 1912 and completed in the year 1915, according to the plans and under the direction of Mr. H. J. Trivess-Smith, M. Inst. C.E., Hydraulic Engineer, Bombay Municipality, Mr. P. R. Cadell, C.I.E., being Municipal Commissioner. The available daily water supply from the lake was thereby raised from 21 million gallons to 49 million gallons; the area of the lake being increased from 6 square miles to 7 square miles and the available capacity from 18,600 million gallons to 29,041 million gallons.

The pipe line was duplicated by a 50in. diameter steel pipe from Newadee to Ghatkoper, and by a 48in. diameter cast iron pipe from Ghatkoper to Bombay. The work was completed at a cost of 70,50,000 rupees and was opened at a ceremony performed in Bombay by H.E. Lord Willingdon, G.C.I.E., Governor of Bombay, on December 8th, 1915. The contractors for the duplication of the pipe line were Mephan Ferguson Proprietary, Limited, of Melbourne, Australia, and for the raising of the dam Messrs. Pallanji Edalji and Son, of Bombay. The average rainfall at Tansa is 94in. (maximum 133in., minimum 40in.). The temperature of the water in the lake varies throughout the year from 73 deg. to 92 deg. Fah.

INSTITUTION OF MECHANICAL ENGINEERS.

GLASGOW MEETING, 1923.

As already announced, the summer meeting of the Institution will be held in Glasgow and will begin on Monday, June 25th. A local reception committee, consisting of the Right Hon. The Lord Provost of Glasgow (Sir Thomas Paxton, Bart., LL.D.), the members of the Institution resident in the neighbourhood, and other Glasgow and district gentlemen, is being formed to make the necessary arrangements. A ladies' committee will make arrangements for the entertainment of ladies during the business proceedings and the visits to works.

Provisional Outline Programme

(*Subject to revision*).

Monday, June 25th.—Arrival in Glasgow.

Tuesday, June 26th.—Morning: The Right Hon. The Lord Provost of Glasgow and members of the local committee will receive and welcome the president, Sir John Dewrance, K.B.E., the Council and members of the Institution with their ladies, in the Examination Hall of the Royal Technical College. Reading and discussion of papers in the Societies' Room at the Royal Technical College. Afternoon: Alternative visits to works in Glasgow. Evening: Conversazione in the City Chambers, by kind invitation of the Lord Provost and Corporation of Glasgow.

Wednesday, June 27th.—Morning: Reading and discussion of papers in the Royal Technical College. Afternoon: Alternative visits to works in Glasgow and neighbourhood. Evening: Institution dinner.

Thursday, June 28th.—Alternative whole-day excursions to the docks by steamboat or Falls of Clyde (ladies included).

Friday, June 29th.—Alternative whole-day excursions to Loch Katrine (ladies included), or Kyles of Bute (ladies included).

CONSULTING ENGINEERS.

We have been asked to make known the fact that the Appointments Department of the Ministry of Labour is anxious to obtain the services of engineers to advise on the qualifications of ex-officer engineering applicants to fill engineering vacancies, and also as to opportunities of employment. This work would entail voluntary attendance at the Engineering Panels at 3/4, Clement's Inn, for two hours once a week or once a fortnight. Any readers willing to offer their services for this work should communicate with the Officer-in-Charge, 3/4, Clement's Inn, Strand, W.C. 2. The advice which consulting engineers can give to the Department and to those unemployed ex-officers is extremely valuable and highly appreciated both by the Department and ex-officers themselves.

Detecting Fire at Sea.—Referring to the article describing the Rich smoke detector which appeared on page 242 of our issue of March 2nd, we may state for the convenience of our readers that any further information with regard to the system may be obtained from the Sperry Gyroscope Company, Limited, of 15, Victoria-street, S.W. 1. The Sperry Gyroscope Company, Limited, represents in Great Britain the interests of the Walter Kiddie Company, of New York, the patentees and manufacturers of the apparatus.

Catalogues for Kenya Colony.—We are asked by the Department of Overseas Trade to state that the Director of Public Works, Nairobi, is desirous of being supplied with priced catalogues of the building and engineering trades for the Department of Public Works. He states that prices are required as a guide and not as a guarantee. Catalogues should be addressed to the Director of Public Works, Public Works Department, head office, Nairobi. It would also be of great interest to his Majesty's Trade Commissioner at Nairobi (Colonel W. H. Franklin, C.B.E., D.S.O.) to receive similar catalogues. In this latter case they should be addressed to his Majesty's Trade Commissioner (P.O. Box 220), Bonia Building, Government-road, Nairobi.

Milling Machinery for Italy.—The British Consul at Turin (Mr. R. L. Noseworthy), in the course of a report on the corn milling industry in Italy, states that as far as can be ascertained no milling machinery has been imported from the United Kingdom in recent years. The sources of supply are Germany and Switzerland, the best regarded firms being respectively Messrs. Amme Giesegke and Konegen and Messrs. Buhler, who supply the complete plants. The latter firm is particularly well known in the Turin district, and last year renewed almost entirely the machinery of a local corn mill. The proprietors of this mill stated that they had in the past invited tenders from the United Kingdom, but prices were too high to admit of business. The Società Meccanica Lombarda of Monza, makes milling machinery and quotes competitive prices, but the German and Swiss products are more favoured. Many of the mills have still to renew their plants or part of their machinery after the wear and tear suffered during the war, and the Consul suggests that British firms should send their illustrated catalogues to the principal mills in his district. It is understood that the millowners would appreciate this step and that offers would be considered seriously. A list of names and addresses of the principal corn mills in the Turin district may be obtained by interested United Kingdom firms upon application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1.

A Seven-Day Journal.

Water for Warrington.

THE Bill that has been brought in by the Corporation of Warrington for powers to enable it to obtain water from the Ceiriog Valley passed its second reading in the House of Commons on Tuesday evening by a large majority, in spite of the opposition offered by Welsh members and particularly by Mr. Lloyd George. The Corporation of Warrington desires to construct two reservoirs in this valley and to impound the water of the river Ceiriog. The flooded area would amount to 13,000 acres, and three villages with eighty-two dwelling-houses would be destroyed. The present population of the valley is about four hundred. The cost of the scheme would be about two million pounds. Mr. J. Davies, of Denbigh, opposed the Bill on the grounds that it was unnecessary, and that the scheme would starve East Denbighshire of the water it needed. He was supported by Mr. Gould, of Cardiff, who asserted that Warrington could get all the water it wanted from Liverpool at far less expense. In reply to these two speakers, Mr. Reid, of Warrington, stated that the supply that could be obtained from Liverpool was insufficient, and that chemical factories in that town had already had to close down owing to the impure water available. Mr. Lloyd George, speaking in support of the rejection, said that there were plenty of desolate moorlands in Lancashire, Yorkshire and Cheshire, and even in Wales that could be utilised for the purpose in view. The Bill would rob the country of an exquisite picture that had been painted by Nature on its surface. He therefore entreated the House not to outrage the sentiments of the whole Welsh population, and suggested that the matter should be referred to a committee which could consider the problem on a broader basis. Sir H. Smith, of Liverpool, said that they were satisfied that the scheme was an absolute necessity, and that there was no reasonable possiblity of finding an adequate supply in a nearer neighbourhood; and Mr. Neville Chamberlain added that even if Warrington were to take water from Liverpool now, the supply would be so small that in a few years' time it would have to look for another source. He agreed as to the necessity of obtaining a general survey of the nation's water, but did not favour the setting up of another Committee. Only ninety-one opponents of the Bill were found in the House, and it was accordingly read a second time.

Taxation and Trade.

SPEAKING as President of the Federation of British Industries at Birmingham on Tuesday last, Sir Eric Geddes made a strong plea for further reduction in taxation. After pointing out that the year 1922 had been one of fairly substantial recovery, with the rate of recovery increasing towards the end, he said that the improvement was undoubtedly due to the reduction of taxation announced in the last Budget. The stimulating effect on industry was far greater than was represented by the actual drop in the national revenue for the year, but our trade was still far below that of the 1913 level, and the only method of restoring it was by the increase of capital. But increase of capital in present circumstances was impossible, and the country, as he saw it, was being taxed out of existence. It appeared that there was hardly any surplus of national income over national expenditure in 1922 to add to our available capital for the employment of our additional and increasing population. The economies already effected by the Government were not sufficient. The trade of the country was being strangled by the high taxation that took the savings which should provide capital which was the life-blood of industry. He was confident that if the Government would take its courage in both hands, it could further extend the economies which it had already begun, and he urged the members of the Federation of British Industries to insist upon further reduction of taxation. There was never a time, he said, when there was greater need for all branches of industry to consult together, and study their common difficulties and to put their point of view before the Government of the day.

The Bristol Fighter.

AT the meeting of the Anglo-American Inventions Commission on Monday the Bristol Aeroplane Company submitted a claim in connection with the supply of "Bristol Fighter" aeroplanes to the United States during the war. It was stated on behalf of the claimants that the machine, of all others, was the most dreaded by the Germans, and that the company had received £50,000 by way of reward in connection with the supply of 2400 machines to the British Government. The American Government decided to produce the type on a large scale, and placed an order for 2000 machines with the Curtis Company. The machines, as produced in the United States, were for various reasons not successful. It was decided to fit them with "Liberty 12" engines, which were at least 400 lb. too heavy for the design. The machines as so constructed were found to be dangerous, and the contract with the Curtis Company was cancelled. Colonel the Master of Sempill, a member of the British Aviation Commission which visited the United States, stated that after having flown sixty-five or seventy different types of aircraft, he flew a Bristol Fighter Liberty 12 machine, and never felt more alarmed than he did during that short flight. He formed the opinion that the machine could not be made successful with this type of engine, and recommended that the Curtis contract should be cancelled. The Inventions Commission, after hearing all the evidence, reserved its decision in the matter.

British Chemical Standards.

WE have received this week from Messrs. Ridsdale and Co., of Middlesbrough, a report covering the work done during the three years ending September 30th, 1922, in connection with the movement for the establishment of standardised samples of iron, steel and other important industrial substances. Since the movement was begun six years ago, it has made steady progress, in spite of the adverse conditions which have prevailed. Twenty-three standard samples have now been produced, and cover practically the whole range of plain carbon steels in regular use, including four alloy steels, two cast irons and a basic slag. Those using the standards now number 450, and among them are ten Government Departments, thirty universities and five railways. The organisation provides machinery for the production and distribution of standard samples which are intended to be used by engineers in their chemical specifications and by chemists for checking and co-ordinating their routine tests and as an aid in settling disputes. Although, so far, the movement has been confined to the preparation of standard samples of iron and steel, the same methods can be applied with equal efficiency to other materials.

London Electricity Supply.

ON Monday the representatives of some forty-five private and local authority electric supply undertakings in the Greater London area met the Electricity Commissioners to give final consideration to a draft order for the creation within the area of a separate electricity district for the purposes of the Electricity Supply Act of 1919. The draft order proposed the setting up of a joint authority which would create and maintain and delegate certain powers to two separate committees, one representative of the companies and the other of the municipal undertakings. The companies, however, held that the joint authority was neither necessary nor desirable, while the London County Council objected to the transfer of some of its existing powers to the proposed joint authority. Counsel for the companies argued that the creation of the joint authority and the appointment of two committees were *ultra vires* to the Commissioners, and asked the Commissioners to give a decision in the matter in order that he might apply for another decision to the High Court. He was supported in his arguments by counsel for the London County Council and for the West Ham Corporation. The Commissioners, however, held that as they had already sought the advice of the law officers of the Crown on the point, it would be improper for them to express an opinion as to whether certain of the provisions of the draft order were *ultra vires* or *intra vires*. The companies' counsel declined to discuss the order until the point had been settled, and as an outcome of his attitude the Commissioners decided to adjourn the inquiry. No date was fixed for its resumption, so that presumably the matter has reached a deadlock, with the possibility of litigation to follow.

The Department of Overseas Trade.

THE Department of Overseas Trade, to the parliamentary secretaryship of which Lieut.-Colonel A. Buckley was appointed on Monday, in succession to Sir Wm. Joynson-Hicks, is now a joint undertaking of the Foreign Office and Board of Trade, and represents a policy of Government assistance to trade which has been taking shape for some forty years. It makes no attempt to regulate trade, but aims at assistance without interference. It was founded in 1917, and that it has done most useful work, and is held in high esteem, is shown by the representations made to the Government for its continuance when it was recently threatened with extinction on the score of "economy." In what manner the Department assists British traders will no doubt be at least partially known to most readers, but it is doubtful if all its activities and all the services it is capable of rendering are appreciated by more than a few. To disseminate knowledge in this connection, the Department has just prepared an interesting pamphlet of thirty-two pages, which may be obtained by British merchants and manufacturers on application from the office at 35, Old Queen-street, Westminster, S.W. 1. The Department, no doubt, has its critics, but it is probable that much of the criticism would disappear if its aims and objects, as set forth in the pamphlet referred to, were fully understood. It is perhaps worth noting that the Department's policy is to encourage contact between its representatives and those whom it seeks to serve by personal visits and calls, rather than by formal correspondence, and that it is open to assist the smallest as well as the largest firm.

The Admiralty and Airships.

ALTHOUGH the Navy Estimates for the next financial year contain no reference to the creation or subsidisation of an airship service, it is known that the Admiralty is greatly interested in lighter-than-air craft. The Burney Imperial Airship Service scheme is, we suppose, still under consideration, but it seems evident that in this and cognate matters no definite steps will be taken until the relations between the Admiralty and the Air Ministry are, as they probably will shortly be, placed on a more clearly defined basis. The Admiralty, it would seem, is not only desirous of securing complete control of all the air services of a naval nature, but, in particular, is anxious to assist the development of the airship for scouting purposes in time of war. A deputation of Members of Parliament, it is understood, is shortly to wait on the Prime Minister with the object of inducing the Government to come to a definite decision regarding the formation of an Imperial airship service. It is urged that such a service would not only facilitate Imperial communications, but would also provide an auxiliary reconnaisance force, which would—or so it is held—relieve the Admiralty of a considerable amount of the difficulty and expense involved in the protection of the trade routes by means of light cruisers.

British Textile Machinery in China.

AN agreement has recently been reached between the British and Chinese Governments that the balance of the Boxer Indemnity—amounting to an annual payment of over £400,000 for at least twenty years—is to be devoted to educational work, mainly among the Chinese younger generation. The Textile Machinery Makers' Association has for some time past been making plans for the establishment of a textile technical school in China, probably at Shanghai, as the Americans have already done, and hopes that a small portion of the annual indemnity payments may be secured to assist its object. By so doing, it is believed the Chinese would be rendered valuable assistance, and British trade would be benefited and placed in a better position to meet the competition of the United States and Germany. It is estimated that the land and buildings required would cost about £100,000, and the machinery £50,000, while the annual upkeep charge would be about £17,000, less fees obtained from the students, estimated at £2000 per year. The scheme would provide for the whole or part-time technical training of from 300 to 350 students in the use of British textile machinery. It would be open to other industries, such as the loom-making and the bleaching and dyeing, to join in the undertaking at any time.

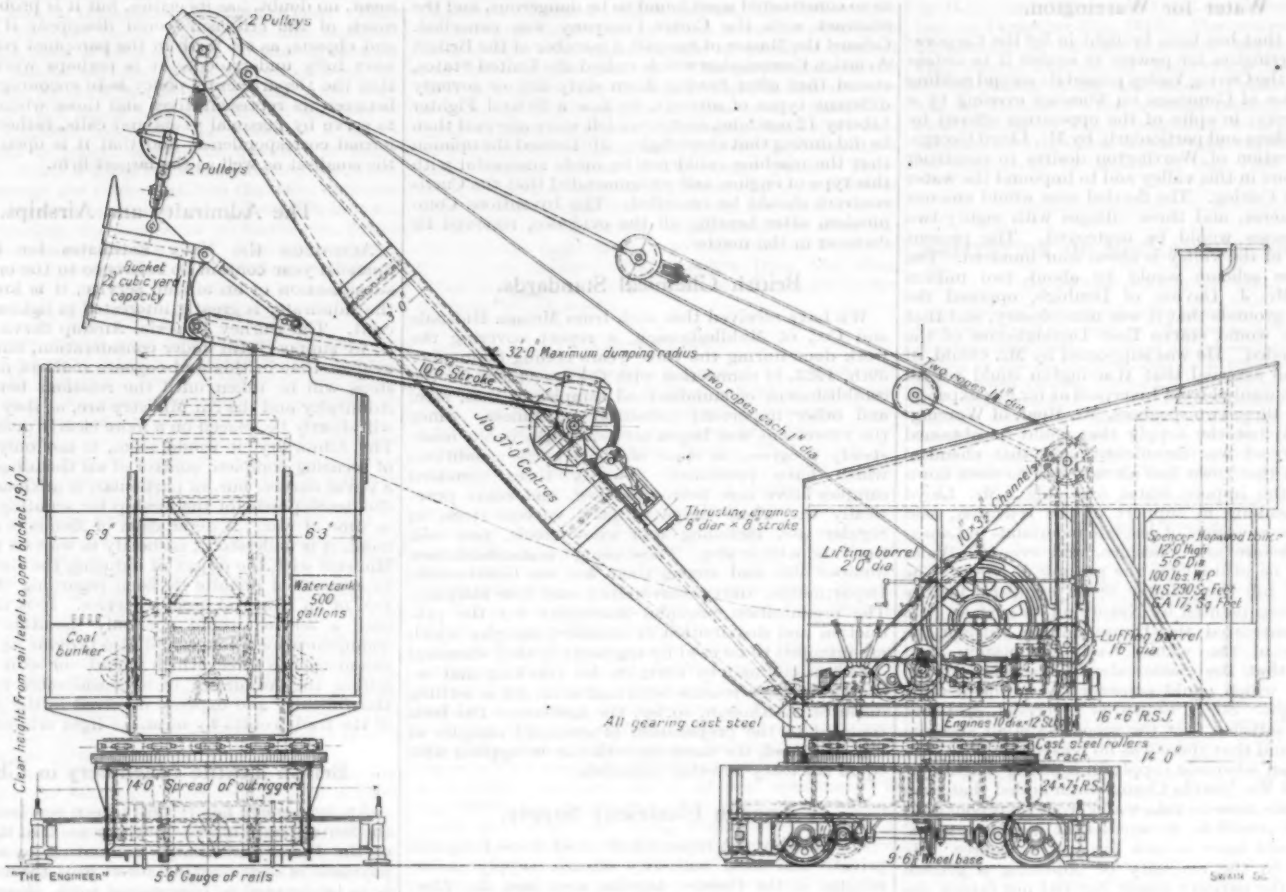
Sixty Years Ago.

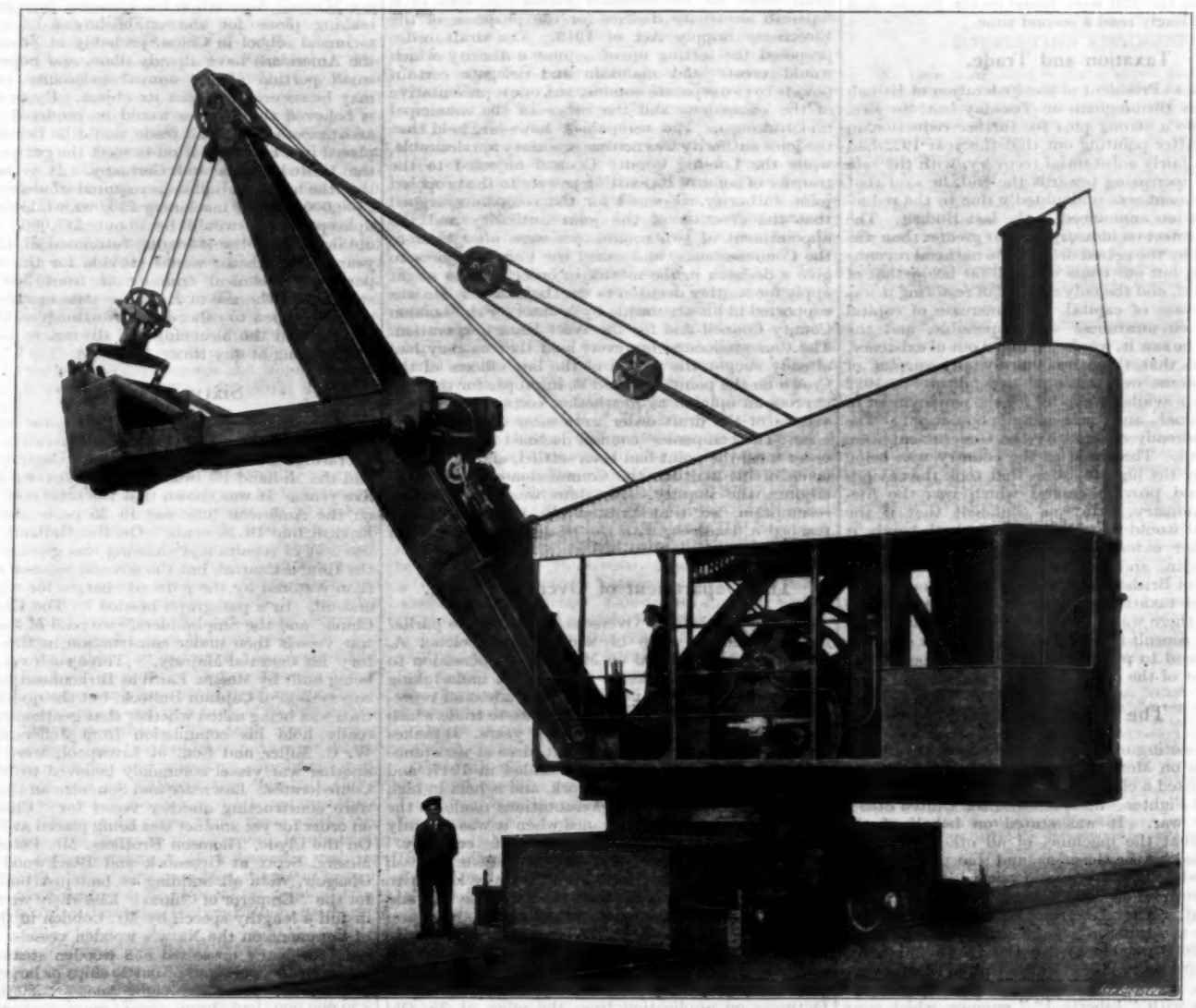
IN our issue of March 13th, 1863, some interesting figures were given showing the comparative costs of operating locomotives on the Illinois Central Railway and the Midland Railway (England), over a period of five years. It was shown that the total cost per mile on the American line was 19.35 cents and on the English line 16.56 cents. On the Midland Railway the cost of repairs and cleaning was greater than on the Illinois Central, but the adverse balance was more than restored by the reduced charges for wages, fuel and oil. In a paragraph headed "'The Emperor of China' and the Shipbuilders," we read of the various war vessels then under construction in this country for "his Celestial Majesty." Three such vessels were being built by Messrs. Laird at Birkenhead, under the supervision of Captain Bullock, but the question even then was being asked whether that gentleman did not really hold his commission from Jefferson Davis. W. C. Miller and Son, of Liverpool, were building another war vessel commonly believed to be for the Confederates. Lawrence and Son, also on the Mersey, were constructing another vessel for "China," and an order for yet another was being placed at Stockton. On the Clyde, Thomson Brothers, Mr. Peter Denny, Messrs. Scott at Greenock and Blackwood at Port Glasgow, were all building or had just built vessels for the "Emperor of China." Elsewhere we reprinted in full a lengthy speech by Mr. Cobden in the House of Commons on the Navy's wooden vessels. At that date the Navy possessed 558 wooden steam vessels, of which 106 were line-of-battle ships or large frigates. During the preceding eight years, something like £30,000,000 had been spent upon material for a wooden navy, which was "now quite useless."

STEAM CRANE EXCAVATOR

JOHN H. WILSON AND CO., LIMITED, BIRKENHEAD, ENGINEERS

(For description see opposite page)





THE GWYNNE-PENNELL ROTARY TRAP

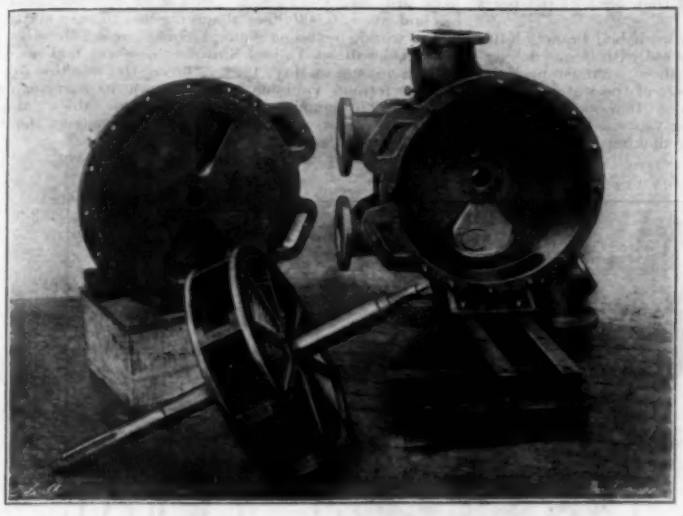


FIG. 1

FIG. 2

Steam Crane Excavators for Bombay.

THREE powerful steam crane excavators are now being made by John H. Wilson and Co., Limited, of Liverpool and Westminster, to the order of the High Commissioner for India, given through Messrs. Meik and Buchanan. These excavators, which are intended for use in connection with the Back Bay Reclamation Scheme for Bombay, to which we have referred on several occasions in the past, are to be employed in loading large broken rock from a quarry into railway wagons. They have a wheel base of 9ft. 6in., and travel on a 5ft. 6in. gauge line. A view of one of them and a dimensioned drawing are given on p. 284. The capacity of the bucket, which can be raised to a clear height of 19ft. above rail level, is 2¼ cubic yards, and the maximum and minimum discharge radii are 32ft. and 18ft. respectively. The jib has a length of 37ft. from centre to centre, and the capacity of the machine as a crane is 15 tons at a radius of 16ft.

As will be observed from the illustrations, the excavators are steam operated. The boiler employed is of the Spencer-Hopwood standard pattern, 5ft. 6in. in diameter and 12ft. high. It has a heating surface of 290 square feet, a grate area of 1715 square feet, and the working pressure is 100 lb. per square inch. It is stated that it is capable of producing 2000 lb. of steam per hour with Indian coal. A steam blower is fitted in the funnel to assist in starting the fire. The feed water tank, which holds 500 gallons or enough for four-hour continuous ordinary working, forms the tail end of the crane and acts as a counter-balance. The coal bunker is on the driver's platform. The main engines which operate the lifting, revolving, derricking and travelling motions have two cylinders each 10in. in diameter by 12in. stroke. They are arranged horizontally, and they drive on to a cross shaft, from which the lifting barrel is driven by single purchase gearing, a steam-operated friction clutch being provided for the purpose. The lifting barrel is 2ft. in diameter, and the bucket is worked by means of four falls of rope 1in. in diameter, two of the falls being direct off the barrel. The revolving gear is actuated by means of double friction cones lined with bonded asbestos and worked by a hand wheel and screw. By this arrangement the machine can be revolved in either direction without reversing the engines. The superstructure revolves on a ring of cast steel live rollers which are bushed with gun-metal. The derricking gear consists of a worm and worm wheel barrel worked by a pronged clutch, the gear being controlled by a screw band brake, which is capable of holding the jib securely in any required position. The jib is raised and lowered by means of a steel wire rope 1in. in diameter. The barrel holds sufficient rope to allow the jib to lower to a height of 20ft. to the centre of the pulleys. The travelling gear, which is controlled by a pronged clutch, comprises a vertical shaft furnished at its lower end with a bevel pinion gearing, with a bevel wheel keyed on a horizontal shaft arranged parallel with the length of the carriage, and with its centre in line with the centres of the travelling wheels. This shaft has, at each end, a bevel pinion which meshes with a bevel wheel through which motion is transmitted to the travelling wheels.

The thrusting gear consists of two cast steel racks fixed to the digging arms and operated by means of two spur pinions mounted on the same shaft as a spur wheel which is driven by a pinion mounted on a shaft, which is revolved by the thrust engines. The latter, which consist of two cylinders each 8in. in diameter by 8in. stroke, are mounted on the jib and are controlled by a reversing steam valve. The maximum stroke of the gear is 10ft. 6in.

The carriage is built up of steel sections, plates and angles, and is furnished with chequer plate covers on the top. There are two sliding outrigger beams on each side. They are each of them fitted with a screw jack, and when the beams are fully extended the centres of these jacks are 14ft. apart, both fore and aft and transversely. The four travelling wheels are 2ft. 6in. in diameter on the tread, and the total net weight of the machine is 52 tons.

As will be observed, a corrugated iron awning is fitted over the machinery, and the boiler and the main control levers are all arranged at the front of the superstructure at the left-hand side. The bucket is operated from a similar position on the right-hand side.

Handling Sewage with a Centrifugal Pump.

WE recently saw at work, in the Hammersmith works of the Gwynne Engineering Company, Limited, a decidedly novel form of apparatus, devised with the object of permitting the use of centrifugal pumps for handling sewage or other fluids which may contain considerable masses of solid material that would choke the pump if it had access to the impeller.

This problem has, of course, been attacked in a variety of different ways. The pneumatic ejector, for instance, has, as is well known, been largely used, and pumps have been evolved which can deal with liquids containing a large proportion of solids. In the latter case, however, the solids have to pass through the passages of the impellers. In the new device, which is known as the Gwynne-Pennell rotary trap, the solids are by-passed, and it is hoped that in conjunction with electrically driven centrifugal pumps it may be widely used for handling sewage in those systems where it is necessary to employ numbers of isolated pumping units. There are also a number of other applications to which the apparatus seems to lend itself, such, for instance, as screening the circulating water systems of power plants which have to draw their water from weed-fouled rivers.

In view of the fact that we had some difficulty at first in following the action of the trap, even when watching it at work, we may be excused for adopting a very homely form of simile and for likening it to a turnstile, while the passenger and his purse might be the solids and the fluids respectively, which have to be handled. The man passes straight through the turnstile—that is, the trap—but on entering he hands his money to the attendant—the pump—who returns the change, and the man with his change passes on, without, himself, having to follow his money through all its movements. The fee charged is equivalent to the loss of head caused by putting the trap in the pipe line.

Considering the matter from a more technical stand-

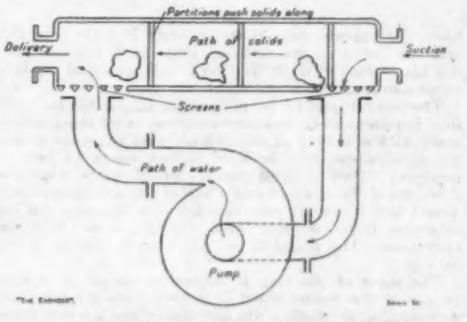


FIG. 4—DIAGRAM TO SHOW ACTION OF TRAP

point, the action may be followed with the aid of Fig. 4, which is purely diagrammatic. Water containing solids that would choke the pump, but which, nevertheless, will pass through the pipe system, enters the apparatus at the suction on the right. The water is sucked through the screen by the pump, but the solids cannot pass. They are, however, pushed forward by the partitions until they come opposite to the discharge from the pump, when they are again picked up by the current of water and thrown out of the discharge with the added impetus represented by the head produced by the pump. It will be noticed that the partitions prevent the short-circuiting of the pump and must be impelled forward, by some external source of power, commensurate with the difference of pressure between the inlet and outlet of the pump.

Such a machine as that suggested in the diagram could not, of course, be put into practical use, as the partitions would all arrive in a *cul-de-sac*, but by bending the path of the solids round into a circle and making the partitions radiate from its centre, we get the essential features of the Gwynne-Pennell trap, which is shown more precisely in Fig. 3. Here, it will be noticed, the suction and delivery are arranged about 135 deg. apart—the rotor moves counter-clockwise—round the edge of the main casing. Inside the casing there is a set of radial arms, which, in rotating, literally push forward any solids which may arrive with the water, towards the delivery. At the same time the water is drawn out sideways by the pump, through disc-shaped screens on either side, and ports cored in the covers of the casing. These ports are plainly shown in Figs. 1 and 2, and are so arranged that the branches from either side are combined into a common pipe for connection with the pump. The water returning

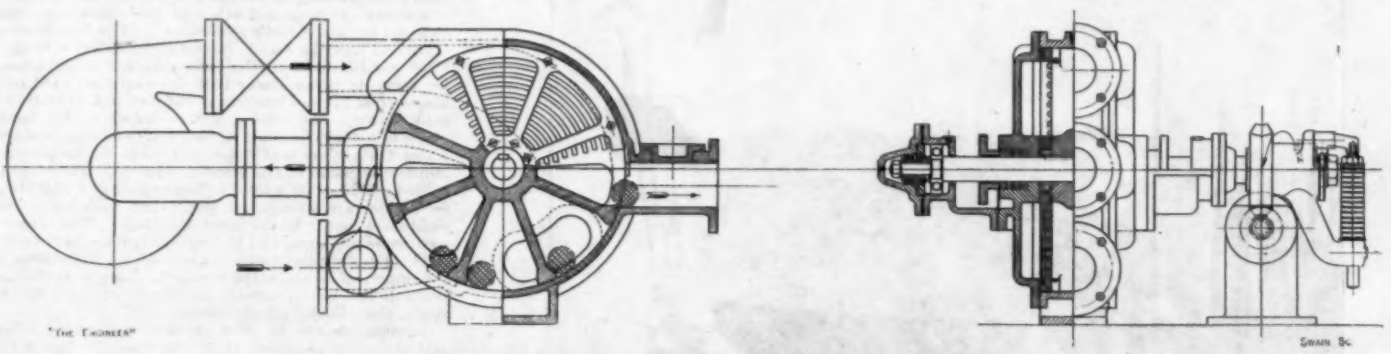


FIG. 3—ARRANGEMENT OF THE GWYNNE-PENNELL ROTARY TRAP

from the pump is delivered to another set of ports, that open on the casing angularly opposite the final discharge outlet, and washes away any material lying between the screens out through the delivery.

It will be readily appreciated that there are two elementary qualities which are essential to the successful operation of the machine. The first is that the screen should not tend to choke up with rubbish and prevent the passage of water, while the second is that no solid which can come through the suction pipe should be able to jam the rotating parts.

The first requirement is met by forming the screen as a series of concentric rings of triangular cross section, so that a divergent opening is offered for the passage of the dirty water. The rings are carried quite loosely in a spider that rotates with the radial partitions, and, on account of their looseness, have a natural tendency to keep clear. At the same time the water returning from the pump, and passing through the screen in the opposite direction, has a powerful scouring action on account of the contracting passages between the rings. We inspected one of these screens after it had been in service for some

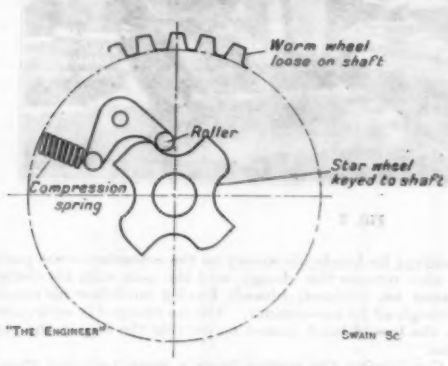


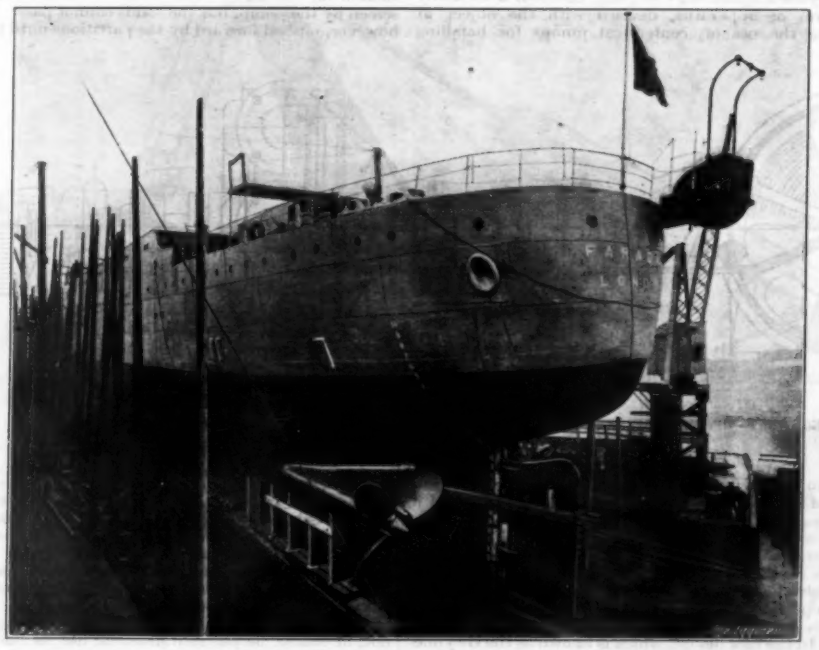
FIG. 5—ANTI-JAMMING GEAR

time, for experimental purposes, and it had very little stuff collected on its surface, while such material as it did carry showed no indication of adherence or tendency to remain long in one place.

The second quality is not often likely to be called into requirement in ordinary practice, as we tried deliberately with a variety of substances, such as lumps of coal, pieces of wood, and balls of cotton waste to jam the machine, They were all passed through without damage. A length of about a foot and a half of ¾in. asbestos packing would not, however, pass through directly, and the gear intended to cope with such contingencies came into operation. The principle of this gear is shown roughly in Fig. 5.

The rotor of the trap is driven by means of a worm gear, but the worm wheel is mounted on a loose sleeve surrounding the shaft. On the shaft there is a star wheel, or cam. A small roller is pressed hard against this cam by a spring, and is rotated with the worm wheel. (In the diagram the roller appears to be fixed on the worm wheel, but it is really arranged on an arm keyed on to the sleeve so as to make it more accessible.) The driving effort is transmitted from the worm wheel to the shaft on account of the resistance of the roller to rising over the peaks of the cam. If the rotor meets a resistance greater than this effort can overcome the roller rides over the cam, compressing the spring in the process. In running back down the opposite side of the cam, under the influence of the recovering spring, the roller gives the rotor a kick-back against the direction of rotation, which gives an opportunity for the release of anything which may be jammed between the rotor and casing or helps to shear it through against a sharp, hard steel, cutting edge, arranged at the outlet. It generally takes only a few strokes of this cam gear to cut through any obstruction, but even in the event of that being insufficient to clear the rotor no harm will result, and the kick-back gear will go on operating. We have kept it working continuously for over twenty minutes, and found that none of the parts were warmed up in the least.

The machine which we saw at work had branches 4in. in diameter, and the pump connected with it was delivering 177 gallons per minute. In these circumstances the loss of head, caused by the passage of the water through the trap, was equivalent to some 40in. on the water gauge, while about ½ horse-power was used to drive the rotor of the trap, when it was making approximately 5 revolutions per minute. Designs have been prepared for traps having capacities ranging from 100 to 800 gallons per minute.

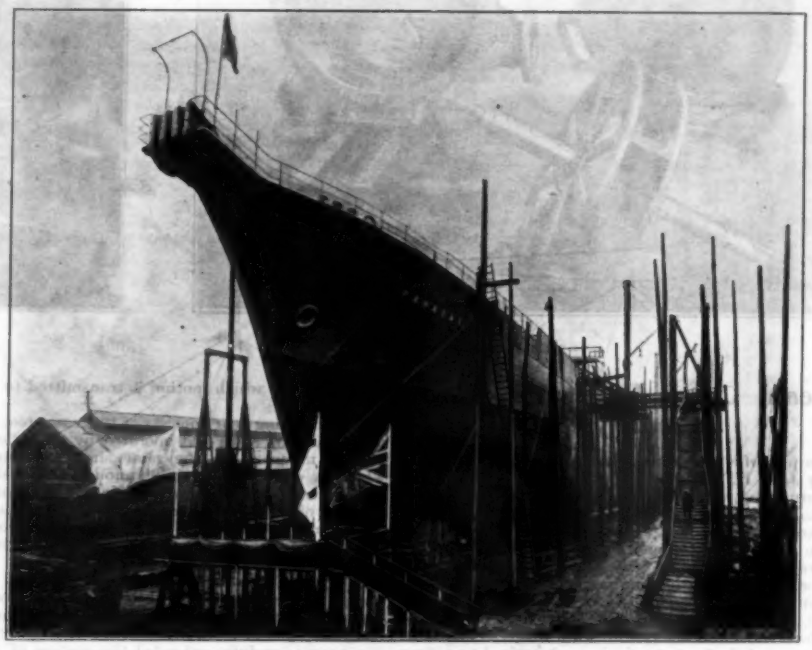


STERN VIEW OF THE FARADAY

The Siemens Cable Ship Faraday.

On the occasion of the launching of the new cable ship Faraday at the Jarrow yard of Palmer's Shipbuilding and Iron Company, Limited, on the 16th of last month, some interesting particulars were given concerning the work of the original cable ship Faraday, which, like the present new ship, is owned by Siemens Bros. and Co., Limited, of London and Woolwich, and is now going out of commission after a period of service approximating to close upon half a century.

The first Faraday was also a Tyne-built ship, and was launched on February 17th, 1874. Her leading dimensions were as follows:—Length, 360ft. 4in.; beam, 52ft. 3in.; hold depth, 34ft. 7in.; gross tonnage, 5052 tons; net tonnage, 2938 tons. She was a notable vessel at the time of her launching, being one of the very early twin-screw ships, with compound reciprocating machinery, while her two funnels placed abreast gave her a distinctive appearance. The Faraday was one of the first ships to be equipped with electric light, and she carried Lord Kelvin's (then Sir Wm. Thomson's) compasses, which have just been introduced. Altogether the old Faraday has laid some 50,000 miles of submarine cables in all parts of the world, including eight Atlantic cables, the first of which—the direct United States cable—was laid on her maiden voyage in May, 1874. During the war this cable ship performed valuable services both in carrying out repairs and in removing old and laying new cables. Many repairs to cables were made in water of varying depths up to 3000 fathoms.



CABLE SHIP FARADAY READY FOR LAUNCHING

The new vessel is one of the largest and most modern ships of her type afloat, and in building her, Siemens Bros. and Co., Limited, have incorporated in the machinery equipment the newest appliances for laying and repairing submarine cables. The ship has been designed to carry about 4500 tons of cable, and she has a steaming radius of 10,000 miles. Built to Lloyd's 100 A1 Class with a steel hull, the following are her leading particulars:—Length over bow and stern sheaves, 415ft.; length between perpendiculars, 380ft.; breadth extreme, 48ft. 3in.; depth moulded, 29ft. 3in.; draught designed, 27ft. 3in.; gross tonnage, 5370; net tonnage, 2640; water ballast capacity, 2200 tons; fuel oil capacity, 1500 tons; speed, 12 knots.

The accompanying illustrations will serve to show the general appearance of the hull, from which it will be noted that a clipper stem adapted for carrying three cable sheaves is provided, and that the cruiser stern is also fitted with cable sheaves on the starboard side. The boilers and machinery are arranged aft, and the vessel has a single funnel, two masts, and a schooner rig. The double bottom is carried right fore and aft and is furnished with an oil-tight middle division, the compartments being arranged for carrying either water ballast or oil fuel. Oil fuel is also carried in cross bunkers at the fore and aft ends of the cable tanks. Separating spaces between the bunkers and cable tanks provide a means of carrying additional water ballast, so that when the cable is discharged an ample immersion of the vessel is ensured. There are four cable tanks, having a total coiling capacity of 91,900 cubic feet, which are arranged *en bloc*. Each tank has a water-tight steel cone. All the internal surfaces of the tank compartments are smoothed to prevent damage to the cable.

The Faraday has two complete decks, the shelter and the upper, while above the former is a long boat deck, and beneath the latter, outside the limits of the machinery space, there is also a lower deck.

Accommodation for the captain, navigating officers, and the cable engineers is provided on the forward end of the boat deck in a large steel house containing a suite of rooms and a drawing-office. The total number of ship's officers, including the cable staff and the crew, will exceed 150 persons, and full lifeboat equipment with motor lifeboats and motor launches is provided on the boat deck. The shelter deck forms the working platform for cable repairing, testing, and jointing, and immediately forward of the main cable machinery hatch is a dynamometer for registering the pull of the cable, while abaft this hatch is a steel house accommodating the control gear for the picking-up machinery. At the after end of the same deck is the paying-out machinery, with its dynamometer, jockey gear, stern sheaves, and handling gear.

The main cable machinery, of Siemens' latest design and built by Palmer's Shipbuilding and Iron Company, Limited, is placed on the upper deck. Throughout the ship very complete accommodation is provided for both crew and cable staff, and there are also ample storage and workshop spaces.

The propelling engines are of the twin-screw triple-expansion type with three cranks placed at equal angles. The cylinders are 21in., 34in., and 57in. in diameter respectively with 39in. stroke, and are designed to develop 2960 indicated horse-power at sea when running at a speed of about 88 revolutions per minute. Special arrangements are made to enable the engines to work very slowly in order that, when necessary, the vessel may be propelled at the slow speed of three-quarters of a knot. Steam is supplied at a pressure of 180 lb. per square inch.

Railway Matters.

THE day service to and from the North of Ireland *vid* Stranraer, which has been suspended since 1914, is to be resumed.

WE have reason to believe that on May 1st—possibly earlier—the running time between Euston and Manchester will be reduced to the pre-war 3 h. 30 m. The trains between St. Pancras and Manchester are to remain at 4 h.

WE understand that the sixty locomotives recently put in hand by Mr. Hughes—twenty at Horwich and forty at Crewe—will be of the 4–6–4 type, and will be practically the same as Mr. Hughes's 4–6–0 express passenger engine, but with the frames extended to accommodate the bunker and tank.

H.M. MINISTER at Caracas has forwarded a copy—in Spanish—of a recent issue of the *Boletín de la Camara de Comercio de Caracas* which contains the text of a report upon railway concessions in Venezuela, by Senor German Jimenez and Senor Vicente Lecuna, Director of the Banco de Venezuela. The copy referred to may be consulted by United Kingdom firms interested on application to the Department of Overseas Trade (Room 41), 35, Old Queen-street, London, S.W. 1.

THE Dominion House of Commons has resolved that the Government should recognise the priority of the Hudson's Bay Railway over other transportation projects started subsequent to it. Of the stretch of 424 miles originally projected 214 miles are already being operated. The grading of the whole length has been completed, and only 19 miles of rails are required. Fourteen million dollars have been expended on the road and 6,000,000 dollars on the terminal at Port Nelson.

THE Manitoba Legislature is urging the Canadian Dominion Government to complete the Hudson Bay Railway. It is suggested that the three Prairie Provinces might unite to finish the road if the Dominion Government should fail to take action. Mr. W. C. McKinnell has proposed that the terminus of the railway should be made a free port of entry for five years, and predicts that if that were done it would become one of the greatest ports on the North American Continent.

THE report by Colonel Pringle on the collision in a dense fog on January 22nd at Queen's-road West signal-box on the London and South-Western section of the Southern Railway, shows that it was caused by the driver of the up Havre boat train over-running the home signal at West London Junction, in consequence of the fogman at that signal failing to show a red light in addition to giving the detonator warning. The driver heard this latter, but getting no other intimation assumed that it applied to the distant signal, and he, therefore, passed the home signal, which he could not see, in the "danger" position.

A SCHEME for the renewal and repair of the French West African railways, rolling stock, and material, requiring a loan of 55 million francs, will possibly be voted by the French Chambers this year. Of this sum, 21 millions would be devoted to the purposes mentioned, 17 millions to the prolongation of the Ivory Coast Railway, 3½ millions to port and river improvement in Ivory Coast and High Sénégal, 7 millions to sanitation and water supply at Dakar and Rufisque, and 6½ millions to miscellaneous purposes. In relation to the working of the railways in 1921, whilst the total length of line in use was 2134 kiloms., receipts amounted to 22,435,000f., and expenditure to 20,557,000f., leaving a profit of nearly 2 million francs.

WE hear that the two commissions which were appointed to investigate the problem of electrifying the Stockholm–Göteborg railway have issued their final report, and the single-phase system is to be adopted. The total length of line to be dealt with is 460 kiloms. The current will be taken from the main three-phase 50-cycle distribution lines for the country, and in order that single-phase 16⅔rd-cycle current may be supplied to the line five motor generator sub-stations are to be erected. The working pressure of the line is to be 16,000 volts. In order to avoid telegraph and telephone disturbances, it is proposed to remove the communication lines to a distance of at least 200 m. from the railway, and to use improved booster track transformers in the trolley lines. Tests have shown that the adoption of these arrangements will entirely eliminate all difficulties.

THE three companies to be absorbed by the Great Western, for which terms had not been agreed by the end of the year, are the Exeter, the Forest of Dean, and the Midland and South-Western Junction. The chairman of the last named, speaking on the 27th ult., said that a difficulty in the way of terms being settled was that the Great Western would not accept liability for the loan made by the Midland Railway. The Midland and South-Western Junction thereupon approached the Midland with a proposal to dispose of the loan, but although that was done on July 25th last no answer had been received up to January 1st, when the matter passed out of the hands of the companies into those of the Railway Amalgamation Tribunal. The amount of the loan, we would add, is £244,000 and interest to the extent of £102,515 had accrued up to December 31st last. Of recent years the interest has been paid regularly.

BOTH lines between Dawlish and Teignmouth, Great Western Railway, are obstructed by a landslide. The Great Western trains for Plymouth and west thereof are, in consequence, reversed at Exeter, St. David's station, and sent over the Southern—London and South-Western—route into Plymouth, North-road. As the trains from London *vid* the Southern Railway enter North-road from the west end, in contrast to the Great Western entering from the east end, the coaches for Millbay and for Cornwall have again to be reversed there. Traffic for Newton Abbot, the Torquay and Kingswear line, and for stations between Newton Abbot and North-road is sent over the Teign Valley line, which branches off south of Exeter and goes through Christow and joins the Moreton Hampstead—Newton Abbot—line at Heathfield. Thus every station is provided for except Teignmouth, and it is covered by a road motor service between Teignmouth and Dawlish. A local train service runs between Dawlish and Exeter.

Notes and Memoranda.

THE construction of a zinc and lead concentrator, having a capacity of 800 tons daily, a lead smelter for the production of pig lead, and an oxide plant for producing zinc oxide, will be undertaken this spring in connection with the Federal Mine, in Lemieux township, county of Gaspe, Quebec.

THE lime sludge cleaned out of acetylene generating plants is used fairly extensively in America in the place of whitewash, and is said to stick on surfaces where the ordinary wash is not satisfactory. The sludge is mixed with water and usually sprayed on with air pressure, in the same manner as is whitewash.

THE Industrial Commission of Yunnan, China, has drawn up and presented a definite programme to the provincial government for the development of the natural resources of Yunnan. The construction of a tunnel has been suggested to divert water from the Mengtsz to irrigate the uncultivated land of Ami. If put through the almost devastated parts of Ami will be turned into productive regions.

DURING a lecture given to the Royal Geographical Society, Dr. R. L. Sherlock said that a calculation of the amount of rock removed in various kinds of excavation by man in Great Britain since the earliest times shows that if the material were spread over the British Isles it would amount to 3.83in. This may be compared with Geikie's estimate of the rate of erosion in the British Isles, which is 2.72in. in 2000 years. In the Black Country of Staffordshire some 230 million cubic yards of waste have been deposited on 23 square miles, but in this case subsidence has probably more than counterbalanced the gain.

AN editorial note in the *Autocar* advocates a greater ratio for the bottom gears of motor cars, which, while providing a bottom gear ratio of about 20 to 1, would avoid excessive differences in ratio between the intermediate gears. It is not enough, it is urged by our contemporary, that a car in thoroughly good trim should be just able to restart on a gradient of 1 in 5 or so; the gear ratios should be so arranged that on a small car with the engine not necessarily running at its best, with a full complement of passengers, and extra luggage, a restart can confidently be made on any main road hill. Bottom gear should be an emergency gear arranged for the climbing of extra stiff hills and to ensure certainty of performance on gradients as steep as 1 in 5.

SOME experiments, carried out on the Gold Coast, with a Tangye four-cycle 28 horse-power engine have shown that palm oil can be satisfactorily used as fuel, and that the engine would start up from cold. The palm oil used contained from 5 to 6 per cent. of free fatty acids. After a continuous run of twenty-four hours the engine was dissembled, when it was found that there was no deposit on the cylinder walls and the piston head, but a slight one on the atomiser and the exhaust valve. The consumption of palm oil was 0.24 lb. per brake horse-power per hour, as compared with a consumption of 0.20 lb. for the mineral oil. It was found, however, that with palm oil the amount of cylinder oil necessary was reduced by 75 per cent. It was noticed that the engine ran far more regularly with palm oil, and that the exhaust gases were quite clear.

ACCORDING to the *Canadian Engineer* the "slump" test is the simplest and most practical method for determining the proper amount of water to use in mixing concrete. The only apparatus necessary is a mould made from sheet metal, preferably non-corrosive, in the form of a frustum of a cone 4in. in diameter at the top, 8in. in diameter at the bottom, and 12in. in vertical height. After thorough mixing the concrete is placed in the mould in three or four successive layers, each layer carefully puddled or rammed with a blunt-pointed ⅝in. round rod. The metal mould is then removed with a steady, vertical lift, leaving the concrete free to spread at the base. The "slump," or reduction in vertical height of the pile of concrete which results, is an indication of the consistency of the mixture. The consistency which produces concrete of maximum strength has a slump of about 1in.

IN the course of a lecture before the Sheffield University, Mr. Dartrey Lewis, of the British Non-Ferrous Metals Research Association, described some results of an investigation of the materials used in polishing metals. He explained that methods had been devised for measuring the abrading or cutting power of materials, on brass and other metals, in the loose powdered form in which they were generally supplied. The relative durability of the materials, or the useful life of their grains before they broke down into too fine a state of division to effect any more useful grinding, had also been measured. The Research Association, suggested that advantage might be taken of some of the superior materials in removing the rougher and thicker layers of metal, whilst sand and pumice should still be used for smoothing off preparatory to the real polishing. Mr. Lewis briefly described some experiments comparing chromic oxide and rouge for polishing steel and silver.

ALTHOUGH Yunnan, China, is rich in minerals, through lack of capital and inadequate means of communication the mining enterprises of the district are not prosperous. More than 7000 tons of tin are produced annually in Kokinchang, but owing to the low price of tin during the last year or two production has decreased. One of the difficulties encountered is the high cost of production and the inferior quality of the output, which has to be refined a second time. Copper is also found in abundance in Yunnan, the largest organisation engaged in mining being the Mining Service Company. Antimony mining in the district was at first carried on by the Pao An Company, capitalised at 300,000 dollars. Its refinery is situated at the Chi Chen railway station on the Yunnan–Annam Railway, and it possesses three modern furnaces, but the antimony mines are so far from the market that the cost of transportation of a ton of antimony to Hong Kong is prohibitive. Many antimony mines have failed lately. Lead is also found in Yunnan, and is mainly exported to Hong Kong.

Miscellanea.

TILES and bricks for interior building purposes can be made, according to the *Chemical Trade Journal*, from the residue of castor oil beans. The cost is very little different from that of stone or mineral composition tiles.

THE London Electric Supply Corporation has secured a contract for fifty years for the supply of the whole of the energy required for the electrification of what was the South-Eastern Railway. The contract means an additional output of between 80,000,000 and 100,000,000 units per annum.

THE wooden steamers which were constructed for the French Government during the war on the British Columbia coast at an average cost of about 200,000 dollars, may now be purchased for about 6000 dollars each. The vessels are of 1400 tons, equipped with twin screws, and are said to be in far better condition than those built to the same specification in American yards.

THREE surveying parties of the Canadian Department of the Interior have returned from the Carrot River Valley triangle, adjacent to The Pas, Manitoba. Three years have now been spent in obtaining information on the reclamation of some 800,000 acres of land in the Carrot River Valley, reported by these engineers to be the richest and most fertile soil known in Western Canada.

IN a written answer to a question by Lieut.-Colonel Nall, Mr. Baldwin said, on March 8th, in the House of Commons, that since April 6th, 1922, the Disposal Board has sold at home a total of 605 motor lorries, and that a further 337 lorries were at present available at home for disposal. It was, he added, not considered desirable, in the public interest, to furnish information as to prices realised.

WHAT is claimed to be a world's record was established by the new 600-ton blast-furnace of the Trumbull-Cliffs Furnace Company, Warren, Ohio, in January last, when, says the *Iron and Coal Trades Review*, 23,364 gross tons of pig iron were produced. Operating entirely on iron ore, the furnaces averaged 753 tons of iron per day for the thirty-one days of the month. During the last two weeks of the month the average daily output was 797 gross tons. The largest single day's tonnage was 921 tons.

A REPORT from Cobalt, published in *Canada*, in regard to the remarkable recent discoveries of silver ore in the Keeley mine, states that one side of vein 26 is plated with a sheet of pure silver from ¼in. to 1in. thick. This wall of native silver is 12ft. long, and is exposed for a height of 8ft., while it may be higher. On the other side of it there is 5ft. thickness of ore which runs one-quarter silver It is suggested that eight hours' work and 25 dollars' worth of dynamite would blow out 5 tons of solid silver, worth some 100,000 dollars.

THE Chesterfield Electricity Committee has approved in principle a scheme for supplying electric light to small houses not already wired for the purpose. The proposal is for the Corporation to fit up the house at an estimated cost of £7, the expense of installation and interest to be included in the unit charge for electricity consumed. It is required that the landlord shall make the use of electric light a condition of tenancy, and, further, that all gas fittings shall be removed. The installation will eventually become the property of the landlord, and the tenant will be required to pay for repairs.

AN application recently filed by the American Superpower Corporation of Buffalo with the Federal Water Power Commission indicates that the company contemplates a large hydro-electric development, including the transmission of power from the St. Lawrence River to New York City and the surrounding metropolitan district. Requests were filed for two preliminary permits, allowing the development of 1,600,000 horse-power in the towns of Waddington, N.Y., and Morrisberg, Ontario, on the St. Lawrence River. Of this total 920,000 horse-power is intended for the United States and 680,000 horse-power for Canada.

DURING the past six months contracts have been fixed up for fifty-one ships equipped with internal combustion machinery, totalling 371,000 tons deadweight. It is somewhat surprising and rather significant, according to the *Motor Ship*, to note that, of them, nineteen are being built in German yards, the tonnage totalling 148,000. The corresponding figures relating to vessels being built in Great Britain are sixteen, with a tonnage of 134,800. Included among these are orders for two motor liners of 20,000 tons and 15,000 tons displacement respectively, two for cargo ships each of 20,600 tons, and, in addition, there are five vessels of between 11,000 tons and 15,000 tons deadweight.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in February amounted to 543,400 tons, or 24,500 tons less than in January, mainly owing to the smaller number of days, for the average daily rate of production was about 6 per cent. higher than in January. The furnaces in blast at the end of the month numbered 189, an increase of six during the month. The production includes 174,000 tons of hematite, 184,800 tons of basic, 125,900 tons of foundry, and 30,300 tons of forge pig iron. The output of steel ingots and castings in February amounted to 707,100 tons, which is the highest output attained since December, 1920, and is higher than the rate of production in 1913.

THE results of the apprentice advancement scheme of the Central Marine Engine Works for the year 1922 were announced last week by the managing director, Mr. Maurice S. Gibb, C.B.E., at a large gathering of apprentices, their relatives, and friends, held in the works canteen at the Central Marine Engine Works, West Hartlepool. A well-designed certificate was presented, for the first time, to successful candidates by Professor C. J. Hawkes, of Armstrong College, Newcastle-on-Tyne. Mr. Gibb gave an outline of the scheme, which, he said, first came into being about thirty-two years ago, when apprentices who were successful in passing the examinations in connection with the technical classes had their class fees refunded by the firm; but the scheme has grown considerably since then, and many revisions and additions have been made.

A MOTOR SHIP'S SHAFT-DRIVEN WINCHES

THE WERKSPOOR COMPANY, AMSTERDAM, ENGINEERS

(*For description see page 296*)

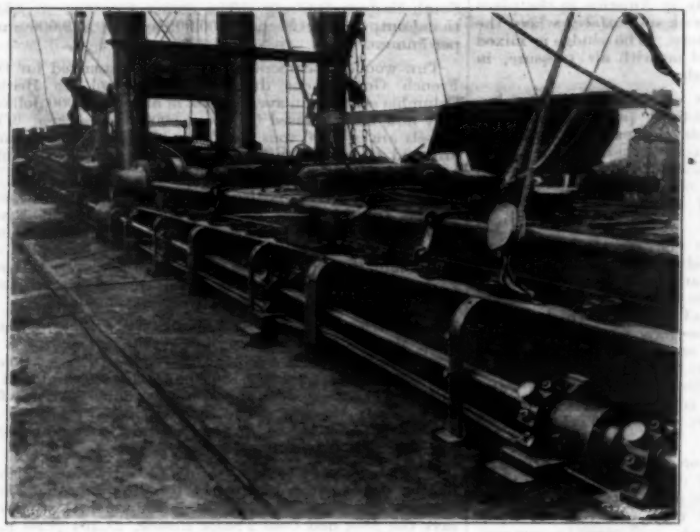


FIG. 1—THE TRANSMISSION SHAFT—FORWARD

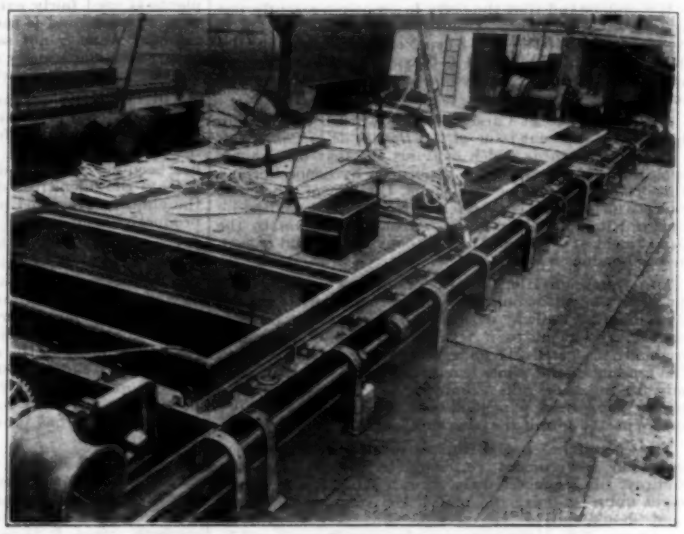


FIG 2—THE TRANSMISSION SHAFT—AFT

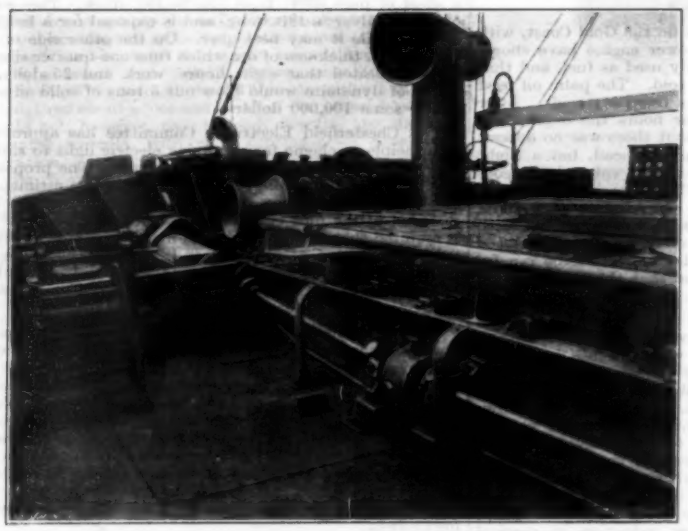


FIG. 3—FORWARD END OF THE SHAFT

FIG. 4—DRIVE FOR THE MAIN WINDLASS

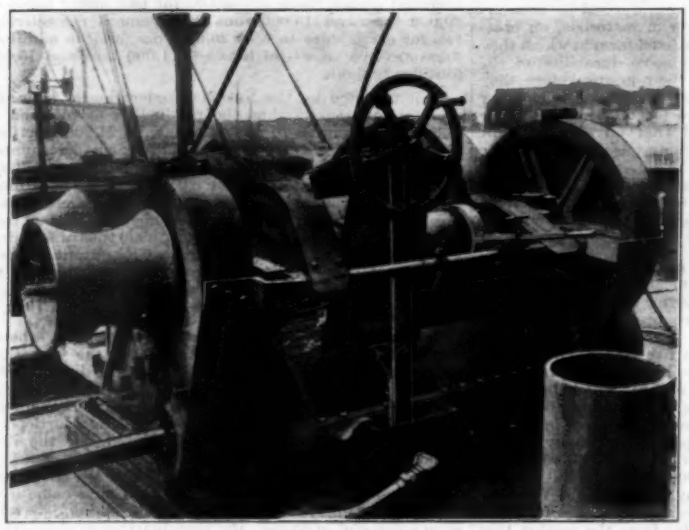


FIG. 5—WINCH WITH FRICTION COUPLING AND CONTROL GEAR

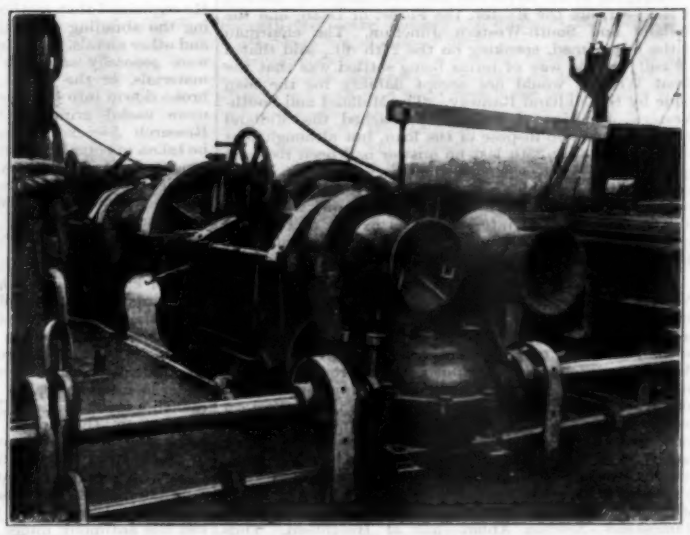


FIG. 6—GEARING AND TRANSVERSE SHAFT FOR WINCHES Nos. 3 AND 4

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The Engineer

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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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DEATH.

On the 13th March, at 27, Brompton-square, JAMES THOMAS JERVIS, M. Inst. C.E.

THE ENGINEER.

MARCH 16, 1923.

The Navy Estimates.

IN preparing its budget for the coming financial year the Admiralty has shown a consideration for the taxpayer which other public Departments would do well to emulate. The new Estimates, as the First Lord reminds us in his explanatory memorandum, reflect the full extent of the programme of retrenchment that was initiated as soon as the Government had accepted the Washington Treaty. That famous covenant has not escaped criticism, nor is it, perhaps, as complete and binding as it might have been; but with all its imperfections it has undoubtedly saved this country large sums of money, and in these times of financial stringency that is something for which we ought to be thankful. In scrapping many ships of war still in their prime, disbanding thousands of highly trained officers and men, and pruning down expenditure on every Vote that contributes to the strength and war-readiness of the Fleet, the Admiralty has taken risks that would be inadmissible in ordinary circumstances; for the Treaty is not fully ratified as yet, and not one of the other Great Powers concerned has begun to reduce its naval armament on anything like the same scale. We, for instance, have already abolished all save one of the capital ships condemned by the Treaty, while, so far, neither the United States nor Japan has discarded a single vessel of modern type. Fortunately, however, there is every reason to hope for the eventual ratification of the Treaty, and though a certain risk has doubtless been incurred in thus forestalling its provisions with regard to the reduction of material, we believe the Government's policy to have been fully justified. In the Admiralty's words, it is an "act of faith" which has secured for the taxpayer the immediate benefit of substantial economies which would otherwise have been deferred. For the approaching year the gross Estimates amount to £61,401,165, a fall of more than £8,000,000 as compared with those of 1922–23, and of £31,000,000 compared with those of the preceding year. The net Estimates are down to £58,000,000, as against £64,883,700 and £83,444,000 respectively for the two preceding years. In gross expenditure, therefore, the cost of the Navy has been reduced in two years by one-third, and in net expenditure by 30 per cent. The non-effective Votes have been inflated by the transfer of a large body of *personnel* to the retired pay and pensions lists, and in the effective Votes provision has had to be made for the building and equipment of the two new battleships, Nelson and Rodney, upon which upwards of £4,000,000 are to be spent in 1923–24. That in spite of these heavy additions the Estimates as a whole have been brought down to a total of 61 millions is gratifying proof of the Admiralty's zeal for economy. Retrenchment has obviously been pushed to the utmost limits compatible with safety, even to the extent of de-celerating the supply of stores needed for war purposes. That "the continuance of this policy can only be justified by the seriousness of the financial situation and by the expectation of a general atmosphere of tranquillity in the sphere of naval armaments" is a proviso to which the country, notwithstanding its earnest desire for financial relief, will readily subscribe.

The least satisfactory feature of this trenchant programme of naval economy is the hardship and disappointment which has been unavoidably inflicted on thousands of men who have deserved well of the State. During the past year alone nearly 20,000 officers and men have had to leave the Navy, and many promising careers have been cut short. While a large number of officers, especially engineers and accountants, took advantage of the special scheme of retirement which came into effect last May, there remained a considerable surplus in the executive branch, and this imposed on the Admiralty the "most difficult and painful task" of selecting some 608 officers for compulsory retirement. Although each case was considered on its merits, and due weight was given to individual records of service and efficiency, it was inevitable that many of the officers thus retired would be those whom the Navy could ill spare. They have been called upon to make a bitter sacrifice, the full measure of which only they are able to appreciate, and there will be general agreement with the First Lord of the Admiralty when he declares that, in seeking to establish themselves in new vocations, these victims of the "axe" have a claim "upon the active and helpful goodwill of their fellow-citizens here and in every part of the Empire." The new system of training for engineer officers promulgated last year has now been in force for ten months. The course, of which three years and eight months are to be spent at Keyham and the remaining four months in the torpedo school at Portsmouth, includes electrical as well as marine engineering. In length of time it corresponds to the average engineering course in civil life, and the Admiralty feels confident that the product will be young officers whose training will fully qualify them to uphold the high traditions of the naval engineering branch. In order to give men of the Navy and Royal Marines a better chance of employment on returning to civil life, a new scheme has been inaugurated, under which vocational training will be imparted to them while still in the service. For this purpose a sum of £2500 has been set aside for the purchase of tools and technical literature, and, contingently, for the part payment of fees to technical colleges. Although this excellent scheme begins on a small scale, it is intended in future to make larger financial appropriations if circumstances permit. We notice with some misgiving that the Vote for scientific services shows a further cut, the saving having been effected by curtailing special research, with the result that all but the most urgent of the problems whose solution would increase the technical efficiency of our naval arm have had to be shelved. With all deference to the Geddes Committee, which reported adversely on the allocation of large sums for the prosecution of such work, we hold to our opinion that economy which inhibits the application of war experience to methods and material is false economy from every point of view. Not a few of the inventions and devices that originated during the war might, if fully developed, enable us eventually to reduce the numerical strength of the Navy without in the least impairing its efficiency for war.

Besides the two new battleships, both of which are being built under contract, new construction at present in hand includes the cruiser-minelayer Adventure, at Devonport, and the submarine X 1, at Chatham. The latter, it is anticipated, will be completed during the approaching financial year. No new vessels are to be laid down in that period, but a small sum is appropriated in the Estimates for preliminary work on a submarine, the keel of which will probably be laid in 1924. The fact that two of the five vessels provided for since the end of the war are submarines is evidence of the value which naval opinion attaches to this type of ship. The hope had been expressed in some quarters that an early start would be made with new light

cruisers of the ocean-going class, in which the British Navy is somewhat deficient. The great majority of our present cruisers, having been designed expressly for service in the Narrow Seas, lack the sea-keeping qualities and the radius of action essential for ocean duty. When current programmes have matured, more than one foreign navy will be better provided than our own with cruising ships of this type, the necessity for which has not, in our judgment, been seriously diminished by the development of the airship. We shall be ready to believe in the airship as a substitute for the cruiser when the former has accomplished some of those trans-oceanic flights which we are promised in the near future. At present the claim of the dirigible to rank as a naval scout rests more upon promise than performance. Contract ship-building for 1923–24 will involve a sum of nearly £3,000,000, all of which is to be absorbed by the two battleships. This amount affords an indication of the large volume of employment which results from the building of a modern capital ship, a point which the workers of Tyne and Merseyside have already had good reason to appreciate. All the dockyard reductions foreshadowed a year ago have been carried out, but in order to ameliorate unemployment in the districts concerned, a sum of £400,000, saved on other Votes, has been spent on work which otherwise would have been done in future years. This measure was taken in pursuance of the Government's scheme for relieving unemployment during the winter months. Reviewing the Estimates as a whole, we shall be safe in assuming them to represent adequate provision for the reduced Navy to which our sea interests must be entrusted during the coming year. The present Board of Admiralty is a particularly strong one, and would scarcely have agreed to these sweeping reductions had it believed them to be inconsistent with the maintenance of a sufficient standard of power in the near future.

The Verdict on the Therm.

THE Departmental Committee appointed by the Board of Trade to inquire into the therm basis of charging for gas has now issued its report, and those who called for a return to the volume-basis of charging are doomed to disappointment. In fact, the Committee not only recommends that the therm system shall be continued, but that it shall be extended to all statutory gas undertakings within the scope of the Gas Regulation Act. The result of the inquiry was not difficult to foresee, and during the hearing of the evidence it became more and more apparent that where representations were made they bore little relation to the therm system *per se*, but merely showed that the average individual with no technical knowledge was incapable of performing a comparatively simple calculation involving elementary multiplication and division. Nevertheless, the inquiry—which was welcomed by the gas undertakings—has done good all round. It has vindicated the therm system, it has certainly proved an education to the gas consumer, it has "broadcast" the new expression so that it no longer appears in the light of a suspicious novelty, and it has given a quietus to irresponsible newspaper reports which conjured up visions of the consumer being exploited for the benefit of a monopoly.

When the matter is viewed from an entirely dispassionate standpoint it must be admitted that the consumer certainly had cause, about twelve months ago, to complain of the magnitude of his gas account. Unfortunately, the bigger bills coincided with the introduction of the therm system, so that the layman with no knowledge of B.Th.U., and no taste for calculations from volume to heat units, immediately jumped to the conclusion that the therm was a clever move on the part of the gas undertakings for concealing an unwarranted increase in charges. Perhaps the best answer which can be given to this entirely wrong impression is the statement which Dr. Charles Carpenter recently made to the shareholders of the South Metropolitan Gas Company, of which he is president. With characteristic candour he pointed out that there was nothing wrong with the therm, but what was wrong was the price which had been charged for it. Here, then, we have a simple explanation and direct admission which will do more than all the technical arguments in the world to disarm the consumer of suspicion; and there is the additional satisfaction of noting that considerable and successive cuts are now being made by all gas undertakings throughout the country. At the moment the situation as regards the price of coal is not too promising, for the standard gas-making varieties have risen by some 3s. to 5s. per ton. For all that, gas in London to-day may be had for 9d. a therm, a price which shows an increase of only some 60 per cent. as compared with pre-war rates. As this proportionate increase is well below the official "cost of living" index figure at present ruling, there must necessarily be many everyday commodities which show very much greater increases in cost than does the product supplied by the gas companies.

An important fact which must not be lost sight of is that (as gas undertakings are governed by sliding-scale legislation) when gas is dear the shareholders suffer equally with the consumers, and for the first time since 1914 the pre-war dividends have only just been reached. In the case of Dr. Carpenter's undertaking the rate is now only 5¼ per cent., a figure which may be regarded as moderate in comparison with some recent declarations by other industrial undertakings. Now that a verdict has been given in favour of the therm as the most equitable unit from the consumers' point of view, we must possess ourselves in patience and wait for the by no means unlikely event of seeing that unit generally purveyed at something approaching sixpence.

The Institute of Metals.

THE financial position of the Institute of Metals, as revealed by the report of its honorary treasurer, Mr. A. E. Seaton, must give grave anxiety to all who are interested in the welfare of that body. Mr. Seaton says quite frankly that the expenditure continues to be in excess of what, in his opinion, is warranted by the income. "The Institute is giving to its members more than it can really afford, and the time has come when that fact should be frankly admitted and the expenditure be reduced to an amount that can be always covered by the average income of the three preceding years." Referring to the treasurer's account, we find that the carry forward is no more than £315, which is obviously far too small to be regarded with complacency, and we are not surprised to hear that the Council is very earnestly considering its whole financial position. The Institute has been in existence for some fourteen years, and there can be no doubt that it has done and is doing very valuable work; but it is now faced with the necessity of either curtailing some of its exertions, however desirable they may appear, or of closing its doors. The second alternative is unthinkable, and we are sure that members will endorse any action recommended by the Council which leads to reasonable economy and the recovery of a stable position. A very brief glance at the balance sheet shows that one item of expenditure is far greater than any other. It is that on the *Journal*, the production of which cost very nearly £2400 last year, or more than half of the entire receipts from subscriptions and entrance fees. It is estimated that in the current year the cost will be no less than £2700. We do not hesitate to say that an Institute with a roll of no more than about 1400 ordinary and student members cannot afford the luxury of such an expensive production.

There lies before us as we write Vol. XXVIII., the second volume of 1922. It is roughly divisible into two parts. Five hundred pages are occupied with seventeen papers and the discussions thereon, and the remainder of the volume is given up to the abstracts of papers relating to the non-ferrous metals and the industry connected therewith, and to an excellent index. The total number of pages in the volume is over one thousand. Since two volumes are issued per year, it will be seen that the amount of literature which the Institute is presenting to its members and students is very considerable. The price of these volumes is one guinea and a-half, and it is satisfactory to learn that the Institute sold over eight hundred pounds' worth last year; but as the net profit per volume is apparently only ten shillings, if as much, it does not go far towards saving the financial situation. The volume is indeed an admirable one on which Mr. Shaw Scott and his staff are to be very heartily congratulated; but it is very evident that the Institute must either curtail its efforts, admirable as they are, or seek for other sources of revenue to meet the ever-increasing expenses. Mr. Seaton points out that the costs of the Abstracts in Volume XXVIII. amounted to £190 more than were spent for the Abstracts in the two preceding volumes, and he goes on to suggest that following the example of the Institution of Civil Engineers, the Institute should separate its Abstracts from its "Proceedings." That seems to be quite a sound proposition, which, we have no doubt, will receive the careful consideration of the Council. By separating the Abstracts the volume would be practically reduced by one-half, and whilst the cost would not fall in precisely the same ratio, the reduction should be sufficient to place the Institute in a sound financial position once more.

Nothing can be more important to a learned society than good "Transactions," for they reach members who are unable to attend meetings, and touch a still larger public of potential members. But the "Transactions" themselves are one thing and the Abstracts another, and whilst the members may reasonably demand the former, there is no reason why they should be presented with the latter. We are convinced that the Institute will find no falling off in its membership if it follows the advice of its honorary treasurer, for the value of its "Transactions" is so high, and they are so extensive, that they alone represent the value of the fees.

Literature.

Ships of the Royal Navy. By Dr. OSCAR PARKES (Editor of "Fighting Ships"). Sampson Low, Marston and Co., Limited. 6s. net.

UNLESS we are much mistaken, popular interest in the Royal Navy is still keen enough to ensure a ready market for a book such as this, which tells all about our present-day fighting ships in language easily understood by the non-technical reader, and contains a hundred photographs of representative types. Here are given, for the first time, authentic details of our latest aircraft-carriers, in regard to which a good deal of mystery has prevailed up to now. This type, as the author remarks, was essentially a war-time production, which has rapidly developed from the elementary stage to one of remarkable efficiency. The progress achieved in the course of eight years is best appreciated by comparing the Ark Royal, of 1914, with the Eagle and Hermes, now completing. The extraordinary appearance of these two last-named ships is well shown in the drawings which the author has been able to prepare from official data. Every other type of vessel in the modern Navy is fully described and illustrated. Beginning with the battleship, Dr. Parkes briefly traces its evolution from the Majestic, of 1895, down to the present Royal Sovereign, giving all essential particulars of each successive class and notes on the war service of individual ships. In his judgment the five Queen Elizabeths constitute "the finest group of fighting ships afloat and one of the best all-round designs ever produced." The "Royal Soverign" ships appear to have been less successful, as we are told that they roll badly, not even the ships fitted with bulges being exempt from this failing. The development of the battle-cruiser is also surveyed. This is a type which is threatened with a premature end, for the Washington Treaty restrictions on displacement are such as virtually to preclude the further building of capital ships with very high speed. Next come the light cruisers and monitors, all of which are carefully sub-classified; then the destroyers, sloops, minelayers, submarines, and the miscellaneous types which the French designate as *poussière navale*. The author has something new and interesting to say about all these vessels, and his notes will help to enlighten the lay reader as to the why and wherefore of certain classes, the functions of which are less self-evident than those, for instance, of the battleship. The pictorial matter is excellent throughout, making the book an artistic souvenir of the modern Navy, as well as a useful work of reference. We are glad to learn that it is proposed to publish a fresh edition each year, and feel confident that the new annual will quickly take rank as a standard guide to current progress in the material of the Royal Navy. We need hardly add that the name of the author is a sufficient guarantee, both for the accuracy of the data he gives and the soundness of his observations on ship design, past, present, and future.

BOOKS RECEIVED.

Official Directory of Members, with Classified List of their Manufactures, of the Association of British Chemical Manufacturers. London: The Association's Offices, 166, Piccadilly, W. 1. Price 10s. 6d. net.

Gas Manufacture, Distribution, and Use: Notes for Teachers. Second edition. London: Compiled and published by the British Commercial Gas Association, 30, Grosvenor-gardens, S.W. 1. Presented.

Bulletin of the Cleveland Technical Institute. A monthly periodical containing abstracts of the most important scientific articles published during the month. Compiled and edited by the Director and Secretary, Mr. Edward L. Johnson. Vol. II., No. 3. December, 1922. Middlesbrough: Corporation-road.

Optical Methods in Control and Research Laboratories. By J. N. Goldsmith, S. Judd Lewis, F. Twyman. Vol. I. (second edition, November, 1922): Spectrum Analysis, Absorption Spectra, Refractometry, Polarimetry. London: Adam Hilger, Limited, 75A, Camden-road, N.W. 1. Price 1s. 6d. net (post free 1s. 8d.).

Institute of Metals.

No. II.*

FIVE papers were on the agenda for the afternoon session on March 7th, when members reassembled at the Institution of Mechanical Engineers. A joint paper by Dr. Rosenhain, Mr. S. L. Archbutt, and Mr. S. A. E. Wells was presented by Mr. Archbutt. It dealt with "The Production and Heat Treatment of Chill Castings in an Aluminium Alloy ('Y')," and an abstract of it follows.

CHILL CASTINGS IN AN ALUMINIUM ALLOY.

The work described in this paper is part of an investigation of aluminium alloys now being carried out at the National Physical Laboratory under the auspices of the Materials and Chemistry Sub-Committee (Light Alloys Panel) of the Aeronautical Research Committee, and under the Engineering Coordinating Research Board of the Department of Scientific and Industrial Research.

In this paper the variable and inferior results which have sometimes been obtained in the chill casting of aluminium alloys have been definitely connected with unsoundness in the chill-cast rods, and it has been shown that they are not due to any of the subsequent operations, including heat treatment. A study of the density of chill-cast bars has shown that this varies from 2.74 to 2.79, and that there may be marked variations in the density of the single bar from the exterior to the core. Correlation of macrostructure with density has shown that such a density gradient is associated with a marked difference in character of structure between the core and the outer portions of the castings, and that this is due to the formation of too deep a ring of so-called chill crystals radiating inwards from the surface of contact with the mould. Such a structure arises from too severe a degree of chilling of the molten metal by the mould, and this is found to result from the employment of chill moulds of too great a thickness of wall.

By a proper proportioning of the cross-sectional area of the mould to the cross-sectional area of the casting, and careful control of casting conditions, it has been found possible to eliminate marked difference in density between the exterior and interior of the cast chill rods, and to bring the density even of the central core of the cast rod to a value closely approaching that of the alloy in the wrought condition (2.80).

This result has an important bearing on die-casting generally, in metal moulds, in connection with the production of castings of maximum soundness and strength. The conditions which have been found to give the best results are as follows:—(*a*) The ratio of cross-sectional area of mould (grey cast iron) to that of the casting to be 3:1; (*b*) the mould, dressed with a thick paste of plumbago and lubricating oil applied in a thin film, to be heated to 150 deg. to 200 deg. Cent., and used tilted to an angle of 30 deg. to the vertical; (*c*) the temperature of the alloy in the crucible during melting not to exceed 800 deg. Cent.; (*d*) the molten alloy to be poured at 750 deg. Cent. in a slow stream, striking the mould as near the top as possible to avoid the danger of a "hot spot"; (*e*) the time taken to fill the mould 7in. deep by 1in. diameter to be not less than 10 sec.

Rods cast in accordance with the above conditions show tensile strength in the neighbourhood of 20 tons per square inch and from 5 to 6 per cent. extension on 2in. If their density is satisfactory, such results can be regularly relied upon after proper heat treatment. In the case of one particular rod, which in the form of a roughed-out test piece was found to have a density of 2.789, the following remarkable tensile test results were obtained after heat treatment:—

Yield stress	17.00 tons per sq. in.
Maximum stress	23.38 tons per sq. in.
Extension on 2in.	14 per cent.
Reduction of area	15 per cent.

No change in density has been observed to result from heat treatment.

No advantage has been obtained in the case of this alloy by the employment of graphite moulds in place of cast iron ones.

The resistance to alternating stresses—fatigue range—of these alloys has been determined, and it has been found that cast heat-treated rod prepared as described in the present paper will withstand twelve million reversals of a maximum fibre stress of 7.0 tons per square inch. The test results indicate a safe fatigue range of ± 7.1 tons per square inch. This result is considerably superior to any values which have hitherto been obtained from cast aluminium alloys.

Heat Treatment.—The use of temperatures exceeding 525 deg. Cent. during heat treatment in a salt bath has been found to cause blisters to form on the surface of castings. Excellent results have, however, been obtained from tensile tests of test pieces machined from blistered rods. At a temperature of 520 deg. ± 5 deg. Cent., six hours is a sufficiently long period of heating. The plunging of the cast rods at normal temperature directly into the salt bath at 520 deg. Cent. has been found to be perfectly safe and free from danger of causing cracking. Similar remarks apply to the quenching operation after heating at 520 deg. Cent. in boiling water.

Mr. R. Genders said that the variable factors were so many that the subject was extremely complicated. He was a little disappointed that the authors had not included in the paper a section dealing with the application of their results to the casting of other metals, although he admitted the difficulty of writing such a section. Referring to the density determinations, he noted that they gave diminishing results as the metal was removed from the outside, and it occurred to him that the same object might have been attained by a rather different method. The authors had not been able to suggest any satisfactory explanation of the occurrence of blisters, but although there was no experimental evidence to support it, a possible explanation might be that the crystals formed in the salt bath, which was distinguished by a rapidity of heating, were associated with the formation of small cavities which might burst and form a blister.

Dr. D. Hanson congratulated the authors on being the first to apply to the casting of non-ferrous metals the methods which had been so successful in the case of ferrous alloys. A point to which he would like to draw attention was the relatively high tensile strength obtained in some of the castings compared with the strength of some of the rolled material, the figure in one case being 23.3 tons per square inch, and in the case of the rolled material only 24 to 26 tons per square inch, which meant that the cast material had practically the same properties as the rolled material. No doubt that particular casting was a good specimen, whereas most castings were bad, but the figure to which he had referred raised hopes that by a more careful study of the conditions under which castings were made it might be possible to improve the quality of the average product. One of the most serious troubles experienced was that of unsoundness. That probably arose either from shrinkage or the evolution of gas, and in the instances quoted in the paper it appeared to him that the main trouble arose from shrinkage. An effort had been made to overcome that trouble, but the method adopted would not be so successful in cases where gases were evolved in the process of solidification.

Professor Thomas Turner found the paper extremely interesting. It had been shown, for example, that the determination of the density of the alloy gave an indication of the tensile strength and of the general character of the material, even although the difference in density between good specimens and bad was comparatively small. He could not agree with Dr. Hanson in his references to causes of unsoundness. He did not think it could be due to gas or to ordinary shrinkage phenomena. There were other explanations. At one moment in the casting of the bar the centre cavity was completely filled with metal, and contraction took place while the inside was liquid, the result being the production of a number of small cavities. It had also to be borne in mind that in cases of this sort material of varying composition was being dealt with. The authors pointed out that there was a difference in density from the outside to the inside, and that might be due to differences in composition. What would happen under normal conditions would be that the material with the highest melting point would solidify at the outside, and that in the inside there was material with a lower melting point quite different in structure and texture from the main body. It was possible to have abnormal segregation, particularly with alloys very low in copper. The remedy for these troubles was a slow rate of cooling and a definite rate of cooling. Time must be given for diffusion to take place.

Mr. Maybrey asked the authors if, in their investigation of the conditions necessary to produce good castings in this alloy, they had thought of the shape of the mould having any influence in the formation of cracks. In casting manganese alloys he had noticed that with the ordinary cylindrical mould there was a tendency for fine cracks to be formed. To overcome that trouble the mould should be so formed as to give a slightly taper shape to the test bar.

Mr. W. B. Clarke referred to the question of porosity of the casting, but could not agree with Dr. Turner in his rejection of the explanation that it might be due to the evolution of gas. His own experience was that when melting was done in a vacuum a perfect casting was obtained, which could be rolled into extremely thin sheets and the finest gauges of wire. At the outset his firm had experienced considerable difficulty, as it was using the old-fashioned sand moulds. These were first replaced with cast iron moulds, but in the end it was found that much better results were obtained when using graphite moulds. These proved satisfactory for use with various metals, even including nickel-chrome. In the case of low-temperature alloys melted in the clay crucible, it was found that the products of combustion were diffused in the metal. It was possible that the absence of a suitable deoxidiser might have something to do with that, and it had been found that an aluminium-titanium deoxidiser gave good results. He had satisfactory experience of the use of the electric furnace for type metal. With regard to the muffle furnace, better results could undoubtedly be obtained if it were made air-tight.

Mr. Archbutt, replying to the discussion, said he did not doubt that the method described in the paper could be applied to other metals. With regard to the suggestion that the shape of the mould might be changed to get rid of unsoundness, he would point out that it had been considered advisable to keep to the same shaped bar because it was a standard bar for experimental work. Personally, he thought unsoundness was due to both gas and shrinkage effects, but that the main trouble arose from shrinkage. With regard to Professor Turner's question, they were now devoting attention at the National Physical Laboratory to the question of composition of the material, although he did not think that that would furnish the explanation. Mr. Clarke had raised a very important point with regard to deoxidisers, and he hoped to make a test of the aluminium-titanium method. Graphite moulds were, he realised, an advantage in many respects, and they had given a test to moulds of that type. They had also tried the electric furnace with a 12 per cent. copper alloy, and obtained a greater degree of unsoundness than by other methods. The annealing had been done in a gas-tight furnace, and the advantage of that was fully realised. In conclusion, he agreed with what had been said as to the need of paying particular attention to the design of the mould; that was undoubtedly very important.

A paper was then presented by Mr. E. A. F. Reeve, of which he is the joint author with Professor F. C. Lea and Mr. V. A. Collins. The title of the paper was "The Modulus of Direct Elasticity of Cold Drawn Metals as a Function of Annealing Temperature." We give below a few extracts from this paper.

ELASTICITY AND ANNEALING TEMPERATURE.

The experiments described in this paper are part of a number of investigations which the authors have undertaken to determine the effect of cold work and subsequent heat treatment on the properties of certain metals. They were carried out on brass tubes, about 1in. external diameter, some "hard" drawn and some "half-hard." The tubes were cut into convenient lengths and were carefully annealed at intervals of 100 deg. Cent. in a gas muffle furnace. The time of annealing in all cases was 30 min., the period being reckoned from the moment the specimens had arrived at the required temperature. At the end of this period the tubes were removed from the furnace and allowed to cool in air.

The difference between the initial values of E in tension for the "hard" and "half-hard" material is about 10 per cent., the effect of work being to lower the value of the modulus. E for the "hard" material varies smoothly and gradually up to an annealing temperature of about 310 deg. Cent., when a sudden increase occurs, and from this point to about 700 deg. Cent. the values lie on a loop, having its crest in the region of 450 deg. to 480 deg. Cent. At 700 deg. Cent. an inversion of the curve takes place, a rapid rise to a value of 7880 tons per square inch occurring after heat treatment at 800 deg. Cent. This loop is the outstanding feature of the curve.

The variation of the "half-hard" material is different from the "hard" material, the modulus remaining greater than that of the latter over the whole range of annealing temperature, with the exception that at an annealing temperature of 800 deg. Cent. the modulus values for both materials are approximately the same. For the "half-hard" material, the points obtained showed a fairly considerable variation in the values of E with specimens annealed at any specified temperature, but the curve as shown is drawn through reasonable mean points. The maximum value of E appears to occur at a lower annealing temperature than for the hard material. Whether the composition affects this point or not is unfortunately not known.

Generally speaking, the values of E are considerably higher than those usually accepted for brasses. The results show that even in the unannealed state, when the value is least, the "hard" material has a modulus of elasticity greater than 6700 tons per square inch, while the "half-hard" has a corresponding value of 7535 tons per square inch. The average values for the "hard" and "half-hard" material over the whole annealing range, representing a mean of eighteen specimens for each material, was 7164 and 7422 tons per square inch respectively. From this it would appear that the values 5000 to 6000 tons per square inch, usually quoted in existing tables, are too low.

Dr. R. H. Greaves thought that the contribution of the authors would be generally welcomed, having regard to the fact that the data provided for critical constants of these metals in books of reference were very variable. The variation was due not so much to errors in measurement as to the method on which they were based, without reference to the range of elasticity. In a paper of the character under discussion, it was most important that the exact conditions under which the measurements were made should be recorded. He did not think the figures for loads were those actually used, as some figures given were outside the elastic limit. With regard to the general question of the modulus of elasticity of these materials, it would add to the value of the paper if the authors would give a definition of the range of elasticity within which it was justifiable to measure the modulus. It was possible in both ferrous and non-ferrous metals to get a considerable departure from proportionality without any permanent set. He noted that the authors found a difference of 10 to 15 per cent. in the modulus in tension and in compression for material in the same condition. Did they think there was actually this sudden change in the relation of stress to strain in passing from a condition of small tension through a state of ease to a small compression? If there was a sudden change at rest it raised a very important question as to the theory of elasticity. It was, therefore, necessary for the authors to give the actual limits of stress between which the changes of length were measured and also the degree of constancy of the modulus.

Dr. F. Johnson asked for further particulars of the Brinell test, including the load and the character of the ball.

Dr. Hanson emphasised what Mr. Greaves had said about the measurement of the modulus of elasticity. There must be a definition of what was meant by the elastic range; otherwise the results stated had no meaning. In a material like pure copper it was impossible to measure the modulus because copper did not appear to be elastic at all. The same observation applied to brasses annealed at about 700 deg. There were other materials which obeyed Hook's law beyond the limit at which the material was elastic. It would be interesting to know if the authors had made any measurements of elastic hysteresis within the range covered by their tests, because it had been found that many materials showed a decided hysteresis loop and the modulus was not a constant quantity.

Dr. Reeve replied to the discussion. The authors regretted that the record given of the tests was not complete, but they had been asked to confine their paper within certain limits of space, and a good deal of experimental data had been omitted. With regard to the load, in no case was it sufficient to stress the material beyond the elastic limit. Dr. Greaves had asked about the stress at failure, and he suggested that the figure obtained was rather high. They had been quite astonished themselves at the compressive strength of the tubes, particularly of those 1in. in length. The stress at failure given was the stress at which the tube collapsed and the specimens buckled. It was not an easy matter to get the hysteresis loop in a material like brass. He was able to say quite definitely that their results indicated that the modulus in tension was quite different from that in compression. With regard to the Brinell test, two loads were used, and the diameter of the ball was very small. The results, if not absolute, were, at any rate, comparative. Dr. Hanson had raised one or two interesting points, but he would point out how difficult

* No. I. appeared March 9th.

it was to fix the elastic limit, as it depended entirely on the accuracy of measurement. In their case, as no hysteresis loop occurred, they took the elastic limit to be the point at which the curve deviated from the straight line, which, he admitted, was not altogether satisfactory. They also measured the bulk modulus of the material, and in that case they got a hysteresis loop, but it was very small.

A paper on "The Structure of Eutectics," by Mr. A. M. Portevin, was, in the absence of the author, taken as read.

Colonel N. T. Belaiew referred to the fine micro-photographs and the deduction made by the authors. There was one practical point he would like to bring to the notice of the meeting, and that was the question of classification. At the last meeting of the Institute the same subject was raised in a paper by Mr. Brady, and as Mr. Portevin was apparently unaware of Mr. Brady's work, it was interesting to compare the two contributions. Mr. Brady had tried to bring together the various phenomena on the assumption that surface tension was one of the most important factors, and he put forward a table of globular, lamellar, angular, and crystalline eutetics, and discussed them in relation to surface tension. Comparing this work with that of Mr. Portevin, it appeared to be a question of different names, and that difference raised the question of classification. The very important effect of surface tension was only, however, mentioned casually by Mr. Portevin, which made it more than ever necessary to take the two papers together.

Professor Thomas Turner said that Mr. Brady's work was carried out in his laboratory, and the paper describing his investigation was his first contribution to the Institute, whereas Mr. Portevin had a world-wide reputation, and his paper was based on wide experience.

Dr. Hanson welcomed Mr. Portevin's contribution to the study of the structure of eutectics. The fact that one constituent formed a continuous phase was important in a study of the properties of the whole mass. Another point which might be emphasised rather more than it had been by the author, was that eutectics were not necessarily a duplex substance. They could consist of 99.5 per cent. of one constituent and .5 per cent. of another, or indeed be entirely composed of one constituent.

Papers by Mr. R. Genders, "The Extrusion Defect in Brass Rods Extruded from a Multiple Die," and Mr. S. Beckinsale, "Further Studies in Season Cracking and its Prevention and the Removal of Internal Stress in 60 : 40 Brass," were presented without discussion.

The session then concluded.

Mr. Leonard Sumner occupied the chair when the Conference was resumed on March 8th.

The first paper taken was that by Mr. R. C. Reader, "Some Properties of the Copper Rich Aluminium Copper Alloys," of which a brief summary follows :—

ALUMINIUM-COPPER ALLOYS.

The present contribution may be regarded as being supplementary to Mr. Stockdale's paper. It deals more particularly with the variations in mechanical properties of the alloys caused by different methods of thermal treatment. The object of the research was to investigate certain properties in relation to which doubt existed or further information appeared desirable. The general outline of the experimental work undertaken is as follows :—(1) Density ; (2) volume changes during and after solidification ; (3) self-annealing properties ; (4) effect of heat treatment on the 10 per cent. alloy.

Self-annealing in aluminium-copper alloys is brought about by the slow cooling of the alloy, resulting in the decomposition of the β constituent into its components α and δ. This latter component, being exceedingly brittle, imparts very disadvantageous properties to any alloy containing it. If the alloy be cooled sufficiently fast to prevent a part of the change, it will possess satisfactory mechanical qualities, while if the alloy be quenched above the critical range—at 600 deg. Cent., a high shock resistance and percentage elongation will result.

If self-annealing sets in during the cooling of an aluminium-copper casting, the useful mechanical properties of the alloy can be largely restored by a suitable heat treatment. The best means of preventing self-annealing are :—(1) By modifying the composition—that is, keeping the aluminium content in the neighbourhood of 9.5 to 10 per cent.—so that in the event of any self-annealing taking place less harmful results will occur than if the 10 per cent. mark be exceeded ; (2) by using as low a casting temperature as is practicable, and so increasing the rate of cooling ; (3) spraying the moulds, in the case of sand castings, as soon as the metal has solidified, thus producing a chilling effect and increased rate of cooling ; (4) removing the metal from the mould as soon as it has solidified and allowing it to cool in the air.

Castings in aluminium-copper should be cast with small lugs attached, so that these lugs may be removed and examined microscopically. By this means, evidences of self-annealing will be revealed. The existence of self-annealing can also be detected in a lesser degree by an examination of a fractured surface, as, when it has occurred, a greyish colouration is observed, while in the case of a normally cooled bar or suitably heat-treated specimen, a beautiful yellow colouration is seen.

Mr. Stockdale, referring to Fig. 6 of the paper, said that the liquidus and solidus were taken from Andrew's work, who in turn had copied it from Curry. The last named stated quite definitely that by the addition of aluminium to copper the melting point of copper was raised. Professor Carpenter, Professor Edwards, Mr. Heycock, Mr. Neville, Dr. Gwyer, and many other members had found that when aluminium was added to copper the melting point of copper was not raised. From that it might be presumed that Curry had been working with copper containing copper oxide. He was afraid the diagram was no evidence either for or against Murray's view in regard to solid solutions.

Professor H. C. H. Carpenter expressed his interest in the figure giving the density of the series. He was particularly attracted by the theoretical curve. It was certainly rather surprising that experimental figures of density should be higher than theoretical figures, because the source of error was nearly always unsoundness in the casting, and that would produce a low result, and he would ask how the author had deduced that theoretical curve. Had he deduced it, for instance, by simply taking the values of the density of pure copper and pure aluminium, because, if so, that would not produce a theoretical curve. He desired to point out that in the case under discussion they were dealing not with mixtures of copper and aluminium but with mixtures of copper and the delta constituent. No figure for the theoretical curve could be obtained unless the density of the copper constituent was known. He did not know that that had been done, and in any case it was very difficult to get, because the alloy exhibited great unsoundness there was considerable shrinkage. Professor Edwards and himself recollected that density determination of the delta constituent was most difficult to obtain. If that was so he thought it explained the discrepancy between the theoretical curve and the experimental curve, because it was in the direction which he would expect. The theoretical curve deduced from copper plus the delta constituent would certainly be higher than that curve. Further, he desired to draw attention to the use the author made of the word "self-annealing," which he did not think was correct. The author said "the term self-annealing of aluminium-copper alloys is used to refer to the harmful results which occur to this alloy when it is allowed to cool slowly." That was a special use of the word "self-annealing" which did not fit the general practice, and he thought the author would be well advised to alter that expression. A self-annealed alloy was one which annealed itself at the ordinary temperature no matter what size it was. The phenomena of self-annealing, using the term in the way in which the author had used it, was simply an effect which was obtained with large castings owing to the rate of cooling. It was not a self-annealing property at all ; it was segregation and nothing else. He thought if the author would re-consider that section of the paper in that light it would be an advantage, because it would take the term "self-annealing" out of the special category into which he had put it, and would describe the phenomenon in terms of what it really was. Rather closely connected with that question was the statement that "A casting of 10 per cent. aluminium-copper alloy, normally cooled, will be in a metastable state, the beta inversion having been prevented." He was afraid he must contradict that statement absolutely so far as the last six words were concerned. The beta inversion took place in every case with normal cooling : that was one thing. Of course, that inversion was beta going to alpha plus delta. Whether there was a segregation into visible alpha and visible delta was another phenomenon which depended on the rate of cooling. The only way in which the beta inversion could be prevented from taking place was by quenching and nothing else. He thought it ought to be realised that there were really two phenomena taking place, the inversion itself and segregation of visible alpha and visible delta, which was purely a question of diffusion. If the author would consider those points it would add to the value of the paper. The great value of the paper was, as Mr. Stockdale had stated, that it placed so much emphasis on the time factor. Those who had worked with these alloys had always realised that, but the paper gave definite experimental figures of the effect of the time factor, and from that point of view he thought it would be exceedingly helpful.

Professor C. A. Edwards made a tentative suggestion in connection with the difference in the hardness which the author obtained when alloys were quenched at 800 deg. and at 900 deg. The point that had to be considered was that the difference of hardness might be associated with the degree to which the changes that normally took place on cooling were altered by the rate of cooling. The curve showing the changes of volume was extremely interesting. He did not know exactly how the data that Professor Carpenter and himself had obtained could be correlated with the author's data, but they did find a peculiar break in the alloys of the alpha series, more particularly in the ductility. The alloys with which Dr. Carpenter and himself had experimented showed an increase of ductility as the amount of aluminium was increased up to 4 to 5 per cent. Then there was a sudden decrease, and subsequently another increase. In a matter of this kind he agreed with Professor Carpenter that careful consideration must be given to the constituents in the various phases. The author quite clearly showed that the rate of cooling materially affected the mechanical properties that were obtained. That was, of course, a function of the degree to which the inversion took place. If alloys containing the beta constituent were to be used in foundries and for engineering purposes generally it was necessary to consider how the velocity of the beta inversion could be retarded by the addition of other elements. If it were possible to examine the influence of varying elements on the rate at which the beta constituent underwent its transformation, and thereby possibly regulate its transformation into a brittle constituent, he thought an extremely useful alloy would be obtained for commercial purposes.

Professor Thomas Turner said the object in view in the paper was to give the manufacturer certain deductions which would enable him to obtain a regular, uniform and satisfactory material. In other words, it should be regarded as the connecting link between such work on the theoretical value as that of Professor Carpenter, Professor Edwards, Mr. Stockdale and others and the manufacturer.

Mr. A. L. Norbury said he had been making a number of tests of specific gravities on solid solutions and other alpha solutions, and he had found in nearly every case that there was a contraction when the element went into solid solution.

Dr. H. W. Brownsdon noticed that the author did not give an analysis of his aluminium-bronze, which personally he considered was most unfortunate, since iron was frequently added and manganese was also said to be highly beneficial in the working of the alloys. He therefore felt that the results of the paper were somewhat limited in application, and he did not know whether he was justified in making any very broad deductions from the results as given. The same point had struck him in connection with the papers read on the previous day, especially that dealing with the casting of the "Y" alloy. In that case small bars of, say, an inch in diameter and a few inches long were taken, and a whole host of data was based on an examination of those ingots. It must be remembered, however, that mass played a very important part in operations on a large scale. It was impossible to deal on a large scale with such small bars ; they were of no use to the practical manufacturer who had to deal with larger units. In that case mass action came in, and under those circumstances the rate of cooling was a very different matter from what it was where smaller masses were dealt with. He thought it was most important to point out that it was possible for the members easily to be misled in making deductions from somewhat small-scale experiments. Another paper on the previous day dealt with the casting problem of similar sized bars in which the ratio of metal thickness to ingot thickness was three to one. The deductions that were drawn in that case were only strictly applicable to that bar ; if a larger size ingot was used the ratio would no longer hold because of the mass of material that had to be dealt with. He felt that both in the case of the present paper and in the case of the paper given on the previous day in reference to "Y" aluminium alloys that the manufacturer was just escaping obtaining that benefit which could be given to him if the experimental methods were taken just one step nearer to the manufacturing processes.

Mr. Reader, in reply, referred particularly to Professor Edwards' suggested explanation of the hardness after annealing from 800 deg. being higher than that of the specimen quenched at 900 deg. Dr. Brownsdon had stated that some of the results put forward could not be applied to practice. It was true that in laboratory experiments small size specimens were usually employed for financial reasons, but as some of the bars that he had used in his work were a foot long he thought that the results were more applicable to commercial conditions than the ordinary laboratory tests.

ELECTRICAL ENTERPRISE IN LUXEMBOURG.

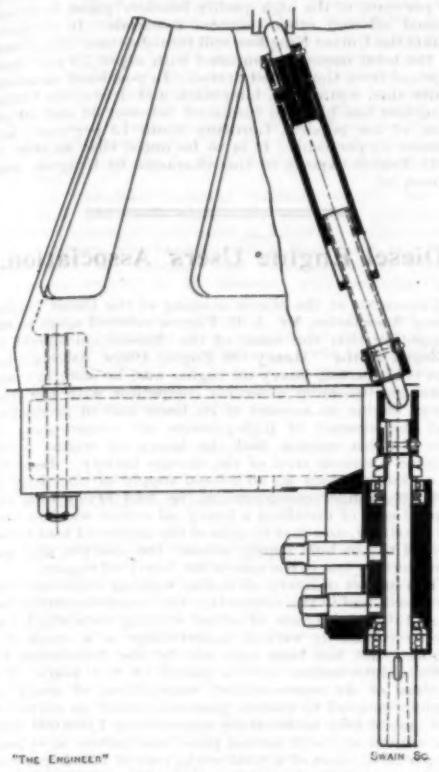
A PROPOSAL of some importance is under consideration in the small but actively industrial Grand Duchy of Luxembourg. It is the unification of the central electric supplies of the whole of the Duchy, in order that the supply of energy for light and power purposes from one or more central stations may be managed as a single concern. No fewer than four different propositions have been drawn up and will shortly be investigated by the Luxembourg Government, and it is thought that there is little doubt that one or other of them will be eventually adopted.

Of the four schemes two emanate from steel manufacturing interests in the Duchy, which would like to see employed for generating power for industrial purposes the large amount of waste gas which is produced in connection with the manufacture of steel. The third suggestion comes from a Belgian company, which offers to construct a steam-power plant using coal ; while the fourth project contemplates utilising water power from the highlands of the Ardennes. The last proposition is destined to meet with an encouraging amount of support. Nevertheless, even if carried out, the scheme would not be capable of supplying continuously the full amount of power required ; for, in spite of the fact that the highlands of the Ardennes afford storage facilities sufficient for keeping the whole of the plant installed in operation during years of normal rainfall, in a dry season, such as that experienced in 1921, there would not be sufficient water to avoid embarrassment.

The various cities and towns of the Grand Duchy at present receive their current from independent plants, the largest being that which supplies the city of Luxembourg. At the present time this service is furnished by one of the plants belonging to the Aciéries Réunies de Beurbach-Eich-Dudelange. The power-house is situated outside the city, and it uses the waste gases from a steel plant. On the other hand, several of the small municipalities in the Duchy secure their current from hydro-electric establishments, while the remainder of the municipalities take their supplies from ordinary coal-consuming plants. It is urged that considerable economies could be effected by the unification of the various services ; and it is believed that a central service for the whole of the Grand Duchy would lead to widely-increased uses of electrical energy in various rural districts which are now more or less without supplies.

Multiple Spindle Vertical Drilling Machine.

THE multiple-spindle drilling machine was, we believe, originated in the United States, and has hitherto been principally made in that country. While it has certain minor disadvantages, such as that inherent in the fact that all



DRILL SPINDLE AND TELESCOPIC SHAFT

the drill spindles must at any one time rotate at the same speed no matter what difference there may be in the size of the individual drills, it is undoubted that for many purposes, particularly for work drilled in jigs, its use leads to distinct economy in time and floor space.

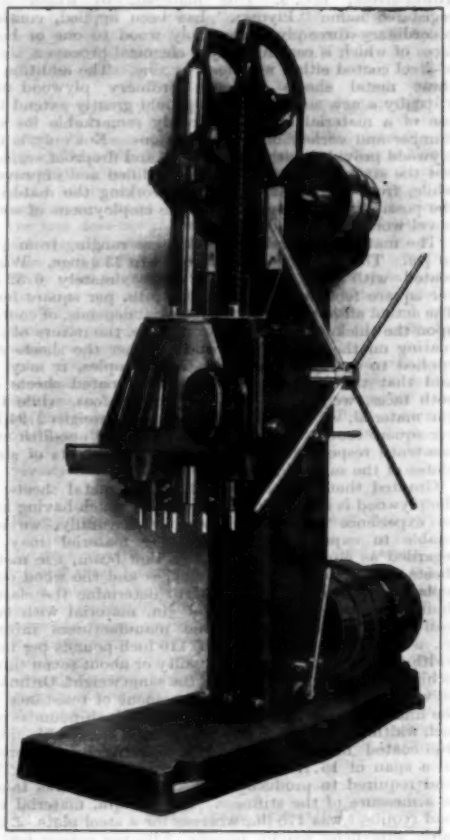
The machine illustrated herewith is an English production, having been designed and made by James Archdale and Co., Limited, of Birmingham. In its general principles it follows established American practice, but is without some of the complications of doubtful value found in the latest Transatlantic models, such as a pneumatic attachment for raising the spindle head clear of the work when drilling is completed.

The drive to the main spindle is obtained by way of a countershaft mounted on the base-plate and carrying fast and loose pulleys and a three-stepped cone. From the overhead driven cone power is transmitted through mitre wheels on to a sleeve within which the main spindle slides vertically on multiple splines. The sleeve is supported at the top and lower end in radial ball bearings and midway is equipped with a ball thrust bearing. The spindle slide, of which we reproduce sectional drawings, comprises a conical casing provided with vertical guiding surfaces and equipped with means for vertical adjustment by hand and for vertical feed by power. The slide is balanced by means of a weight suspended inside the machine column, the connection between the slide and the weight being made by means of chains attached to two double quadrants on a shaft at the top of the column. Eight lengths of chain in all are used. Four of them, those on the inside are one link longer than the others and only come into action if the other chains or any one of them should break.

The lower end of the main spindle is supported within the spindle slide in radial and thrust ball bearings and carries a gear wheel which engages with eight surrounding pinions on eight short vertical shafts. From each of the latter a telescopic shaft with a universal joint at each end establishes connection with one of the drill spindles, as shown in the first line engraving. The drill spindles are carried in sleeves attached by means of studs to slotted knee pieces, which in turn are fixed in a similar manner to the underside of the conical casing. It is thus possible to adjust the drills independently over a circular area 15in. in diameter and also to adjust the position of each spindle vertically to suit varying lengths of drill.

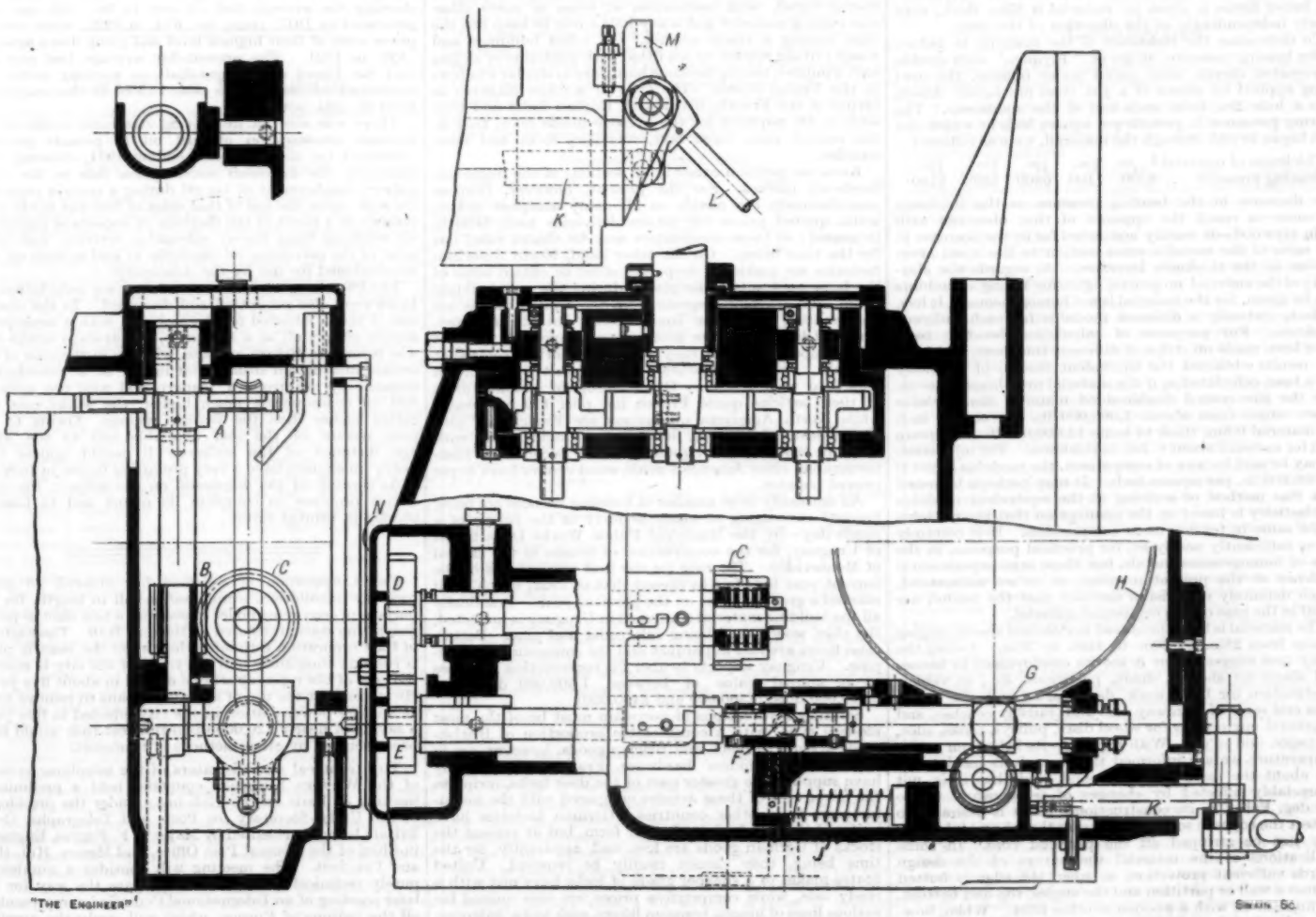
The vertical adjustment of the spindle slide is effected from the large star handle shown in the half-tone engraving, the shaft of which wheel carries a pinion engaging with a rack attached to the face of the column. Automatic feed can be applied to the spindle slide at either of two rates. The details of the feed mechanism are included in the second line engraving. The motion originates at a wheel A engaging with the pinion on one of the eight drill spindles, and is therefore derived directly from the motion of the main spindle. Passing through a worm B and worm wheel C, it is carried by way of two gear wheels D E to a shaft articulated at F. The articulated portion is provided with a worm G which meshes with a worm wheel H on the shaft of the hand-adjustment arrangement. The articulated portion of the worm shaft is mounted in a bracket supported by trunnions collinear with the joint F in the shaft. The worm G tends to drop out of engagement with the worm wheel H under the action of the spring J, but while drilling is in progress is prevented from doing so by the plunger K, the longitudinal position of which is governed from the handle L. An extension M is provided on the handle to co-act with an adjustable stop on the side of the machine column so as to permit the power feed to be knocked off automatically at any desired point. Two rates of feed, 130 and 236 revolutions per inch, are obtainable according as the wheels D E are as shown or interchanged. It will be noticed that these wheels are not held on their shafts by nuts, but by means of annular ribs on the inside of the cover plate N. It should also be noticed that the worm C is mounted on a friction arrangement in order that a connection may be provided which will slip in the event of an excessive overload arising.

Under test, we are informed, the machine has drilled eight ⅞in. holes simultaneously in mild steel at a rate of penetration of 2½in. per minute. It admits a maximum



ARCHDALE'S MULTI-SPINDLE DRILLING MACHINE

height of 3ft. 10in. between the spindle ends and the base and a width of 13½in. from the centre of the spindle slide to the face of the column. The spindle slide has a total vertical traverse of 13in. The spindles, as already stated, may be adjusted in position over a circular area of 15in. diameter and may be brought to 2½in. from each other. With the driving pulley running at 630 revolutions per minute the spindle speeds are 300, 385, and 500.



SECTIONS AND DETAILS OF SPINDLE SLIDE

Reinforced Plywood.

An interesting new form of plywood has just been placed on the market by Venesta, Limited, of 1, Great Tower-street, E.C. 3. This material, to which the registered name "Plymax" has been applied, consists of ordinary three-ply or multiply wood to one or both faces of which is cemented by a chemical process a sheet of steel coated either with lead or zinc. The addition of these metal sheets converts ordinary plywood into virtually a new substance, and should greatly extend the use of a material which is already remarkable for the number and variety of its applications. Not only is the plywood provided with a protective and fireproof surface, but the structural properties are modified and improved, while, from the point of view of working the material, the possibility is opened up for the employment of some novel workshop methods.

The material is made in thicknesses ranging from $\frac{1}{16}$in. to $\frac{1}{4}$in. The steel sheets are from 30 to 33 gauge. When coated with lead they weigh approximately 0.32 lb. per square foot, and with zinc 0.49 lb. per square foot. The actual all-in weight of the material depends, of course, upon the thickness of the plywood core, the nature of the coating on the steel sheets, and whether the sheets are applied to one or both sides. As examples, it may be said that the $\frac{1}{16}$in. material with lead-coated sheets on both faces, weighs 0.975 lb. per square foot, while the $\frac{1}{4}$in. material, with two zinc-coated sheets, weighs 2.94 lb. per square foot. These figures are roughly one-fifth and one-tenth respectively of the superficial weights of steel plates of the same thicknesses.

Granted that the attachment of the metal sheets to the plywood is satisfactory—a point on which having had no experience with the material structurally, we are unable to express an opinion—the material may be regarded as equivalent to an I-section beam, the metal sheets taking the place of the flanges and the wood core replacing the web. Under test to determine the elastic limit in bending, a specimen of $\frac{1}{16}$in. material with two lead-coated sheets showed, the manufacturers inform us, a moment of resistance of 116 inch-pounds per inch width at the limit of proportionality or about seven times as high as that of a steel sheet of the same weight. Ordinary plywood of $\frac{1}{16}$in. thickness has a moment of resistance at the limit of proportionality of about 75 inch-pounds per inch width. To test the stiffness, strips of the double-sided lead-coated material 1in. wide were freely supported on a span of 18.15in., and were centrally loaded. The load required to produce a deflection of 1in. was taken as a measure of the stiffness. For the $\frac{1}{16}$in. material the load required was 175 lb., whereas for a steel plate of the same superficial weight, namely, 2 lb. per square foot—that is, a sheet 0.048in. thick—the load required, according to calculation by the ordinary theory, would be but 2 lb. Thus weight for weight "Plymax" is claimed to be at least eighty times as stiff as mild steel. As compared with ordinary birch plywoodof the same superficial weight, experiment shows it to possess twice the stiffness as thus defined. The stiffness of strips of three-ply wood depends, of course, upon whether the strips are cut with the grain of the outer plies running lengthwise or transversely. Thus birch plywood 0.57in. thick has a "straight-grained" stiffness of 75 lb. per inch width, and a cross-grained stiffness of only 50 lb. In the case of "Plymax," the latter figure is given by material 0.25in. thick, very nearly independently of the direction of the grain.

To determine the resistance of the material to failure under bearing pressure, strips of "Plymax," with double zinc-coated sheets, were tested under tension, the load being applied by means of a $\frac{1}{4}$in. steel pin lightly driven into a hole 2in. from each end of the specimens. The bearing pressures in pounds per square inch at which the pins began to pull through the material, were as follows:—

Thickness of material	$\frac{3}{16}$in.	$\frac{1}{8}$in.	$\frac{1}{16}$in.	$\frac{1}{8}$in.	$\frac{1}{4}$in.
Bearing pressure ..	8500	7400	6800	6400	6100

The decrease in the bearing pressure as the thickness increases—a result the opposite of that observed with plain plywood—is readily accounted for by the decrease in the ratio of the metallic cross section to the wood cross section as the thickness increases. As regards the elasticity of the material no general figure for Young's modulus can be given, for the material is not homogeneous. It has, in fact, virtually a different modulus for each different thickness. For purposes of calculation bending tests have been made on strips of different thickness, and from the results obtained the equivalent moduli of elasticity have been calculated as if the material were homogeneous. For the zinc-coated double-sided material the modulus figure ranges from about 1,000,000 lb. per square inch for material 0.8in. thick to some 14,000,000 lb. per square inch for material about 0.1in. in thickness. For mild steel, it may be said by way of comparison, the modulus figure is 28,000,000 lb. per square inch. It may perhaps be noted that this method of arriving at the equivalent modulus of elasticity is based on the assumption that the modulus is the same in tension as in compression. It is certainly so, or sufficiently nearly so, for practical purposes, in the case of homogeneous metals, but there is no experimental evidence at the present moment, or so we understand, which definitely establishes the fact that the moduli are equal in the case of this compound material.

The material is being produced in standard sheets ranging in size from 28in. by 20in. to 84in. by 36in. Among the many uses suggested for it are its employment in houses and shops for shelves, doors, partitions, &c., in vehicle construction for body work, dashboards, and the roofs, sides and seats of tramway cars and railway coaches, and in general engineering for wheel discs, pulleys, tanks, silos, lift cages, and so on. With regard to its behaviour under temperature, we are informed that as a heat insulator it has about the same value as wood, and that it is not appreciably affected by changes of temperature up to 212 deg. Fah. In its constructional use it is desirable to protect the edges in some way in order that the metal sheets may not be stripped off the plywood core. In some applications of the material the nature of the design affords sufficient protection, as when the edge is butted against a wall or partition and the angles, top and bottom, are finished off with a wooden or other fillet. When, however, the design calls for the edges being left exposed it is desirable to protect them by sweating a light channel section over and along them. Various methods are available for joining the edges of two plates together, as in partition work. For a right angled or other bend a neat job can be made by removing a strip of the covering metal on the inner side of the bend, cutting away the wood below in a groove of the requisite angle carrying the cut down to, but not through, the outer metal sheet, folding it at the cut, and joining up the cut edges of the plate on the inner side by means of solder. The material can be supplied by the makers curved to a variety of radii provided the metal covering is required only on the inner side of the curve. It can be readily cut by means of a circular or band saw, or, for small cuts, by means of a hand saw. Special saws and tools for dealing with it have been produced by Sanderson Brothers and Newbould, Limited, of Sheffield. Wire nails may be driven through it without its having previously been drilled, and if the sheet is to be affixed by means of screws the holes can be formed and countersunk at one operation by means of a punch, which not only pierces the hole but simultaneously countersinks it by compressing the wood and pressing the sheet metal downwards into the cup so formed.

Building Activities in the Argentine and Uruguay.

Exceptional activity prevails in Argentine building circles, new contracts comprising governmental, municipal and private undertakings. In the Municipality of Buenos Aires alone, during the first months of the current year, over 5000 building permits were taken out, while a contract has been granted by the Argentine National Housing Commission for the immediate construction of 80 workmen's dwellings in the Flores district, part of a scheme to provide 10,000 houses contemplated at the rate of 1000 per annum. In fact, sufficient contracts have been entered into to keep the Argentine building trades busy for several years to come. The principal contractors are La Compania Constructiones Modernas, of Buenos Aires. In consequence, there has arisen a heavy demand for builders' hardware, all classes of which are used in Argentina, just as all classes of construction are met with, providing they are of European dimensions and design.

Owing to the insistent demand, importers of builders' hardware have been caught short of supplies, stocks of most lines having almost run out. Large orders are being feverishly dispatched to Europe for door and window-locks—both of the expensive and cheaper grades—padlocks, hinges, bolts, door-bells, &c. British manufactures remain in high favour, and their use is almost invariably stipulated for in building contracts, especially for office buildings and superior private residences. A few lever handles and escutcheons are of French manufacture, but they are higher priced than similar British goods. French designs are usually in cast brass, on which considerable handiwork has been expended in chasing. There is little call now for German goods of this character, although at one time they were pushed vigorously. The padlocks most saleable are fitted with the cylinder type of key; but a ready sale of other types is found, particularly among farmers and hacienda owners. A large galvanised iron padlock, between 2in. and 4in. in length, that may be master-keyed, with mechanism of brass or some other non-rusting material and a key-hole cover to keep out the rain, finding a ready market. All office buildings and many private residences are fitted with guillotine or sliding sash windows, taking the same hardware as similar windows in the United States. The type of window hitherto in favour is the French, fitted with English locks and trim such as are required for the average inside door, that is, the narrow case, large bolt, morticed locks and lever handles.

Keen competition exists in all sections of the Argentine hardware market. For the present, however, German manufacturers are unable to fill many accepted orders, while quoted prices for future deliveries have latterly increased; so these competitors may be almost ruled out for the time being. On the other hand, North American factories are making a desperate effort to obtain some of the large contracts to be placed during the new building boom, and travelling agents from the United States are undercutting all other competitors. British manufacturers of light hardware goods are endeavouring to meet this competition, but they find the market somewhat difficult. French competition is being met with more in regard to wood-screws. Other European manufacturers of these articles quote French list plus 110 per cent.; while North American quotations are French list plus 25 per cent. Importers, however, are holding back with the hope that European quotations may become still more favourable, since American-made wood screws have never proved popular.

An unusually large number of building licences are being granted—averaging as many as forty in the course of a single day—by the Municipal Public Works Department of Uruguay, for the construction of houses in the capital of Montevideo. The rate for the first two months of the current year bids fair to exceed that of 1922, which itself marked a great advance on the previous year. Practically all the building material consumed in Uruguay is imported, the chief woods used being oak, cedar and pine. Better-class floors are laid in parquet and the commoner in pitch-pine. Uruguay imports lumber for construction purposes to an annual value of between 1,500,000 dols. and 2,000,000 dols. (£300,000 and £400,000).

Sanitary installations of porcelain must be of the most modern type, with a considerable proportion of British-made articles; French and Belgian goods, however, are in demand. In builders' hardware, France and Germany have supplied the greater part of the door locks, owing to the lower cost of these articles compared with the manufacturers from other countries. German factories have imitated these locks in a cheaper form, but at present the stocks of German goods are low, and, apparently, for the time being, they cannot readily be renewed. United States makes of a cheaper grade of locks have met with a ready sale, while competitive prices are also quoted for various lines of hinges, transom lifters, sash locks, balances, pulleys, door checks, and padlocks. Sweden is gradually coming into the market again as a maker of cheap hinges in substitution for those of German origin, which, again, were a cheap imitation of American goods. Lever handles for windows are almost universally used with escutcheons in plain brass, nickel plate, and, for economy, small brass nickel-plated key-plates, instead of long escutcheons. Practically no demand exists for the wrought brass or steel trimmings used on lower-grade work, smaller pieces being preferred to cheaper material where economy is desired.

The United Kingdom has hitherto supplied nearly 80 per cent. of the high quality builders' paint, including linseed oil and other painters' materials. In prepared paints the United Kingdom still furnishes over 50 per cent. of the total imports, compared with about 29 per cent. received from the United States. In powdered materials, white zinc, white lead, lampblack and driers, the United Kingdom has hitherto furnished between 35 and 40 per cent. of the imports, Germany about 15 per cent., and France 40 per cent. It is to be noted that anterior to 1911 British exports of this character to Uruguay were almost nil.

Diesel Engine Users' Association.

Presiding at the March meeting of the Diesel Engine Users' Association, Mr. A. E. Farrow referred again to the suggestion that the name of the Association should be changed to the "Heavy Oil Engine Users' Association." The cold-starting heavy oil engine was, he said, in many instances becoming a serious competitor with the pure Diesel engine on account of its lower cost of production and the absence of high-pressure air compressors. It was also his opinion that the heavy oil engine would become a serious rival of the storage battery. Recently in a case in which an additional supply of electricity in bulk was under consideration, he had found that the capital cost of installing a heavy oil engine was less than for a battery, and that in spite of the improved load factor offered to the bulk supply scheme the cost per unit was considerably less in the case of the heavy oil engine.

The subject of heavy oil engine working costs was fully discussed, and in this connection the committee submitted some tabulated figures of actual working costs which had been returned by various undertakings as a result of a request that had been sent out by the Association for definite information over a period of five years. The average of six representative installations of heavy oil engines coupled to electric generators with an output in the case of each undertaking approaching 1,000,000 units per annum and with annual plant load factors of at least 15 per cent., showed a total works cost of 1.08d. per unit in the year 1921 which, allowing for the reduction in the costs of labour and material, corresponded to a present-day average works cost of .789d. per unit generated. In arriving at this figure the maintenance cost had been taken as the average of five years. It was pointed out that, except in the case of installations in which a large number of engines might have been installed at varying dates, it was necessary to work out an average figure for maintenance costs over a period of about five years in view of the irregular incidence of certain comparatively heavy costs, such as the renewal of liners, pistons, &c.

Some figures were given of the fuel oil costs of the six representative heavy-oil engine installations referred to, showing the average fuel oil cost to be .52d. per unit generated in 1917, rising to .67d. in 1920, when fuel oil prices were at their highest level and going down again to .53d. in 1921. The present-day average fuel cost per unit for Diesel engine installations working under the conditions referred to was stated to be in the neighbourhood of .33d. per unit.

There was also an interesting statement made of the average consumption of fuel oil in pounds per unit generated for the five years ending 1921, showing very distinctly the increased consumption due to the compulsory employment of tar oil during a certain period in the war, when the use of that class of fuel was made compulsory as a result of the shortage of imports of petroleum oil resulting from enemy submarine activity, and when most of the petroleum oil available, as well as shale oil, was requisitioned for use by the Admiralty.

The Diesel engine working cost for two installations in India were also submitted and discussed. In the case of one of them, situated on the seaboard with a consequent supply of fuel oil at a low price, the average works cost was below the British average, whereas in the case of the second installation situated far inland at a considerable distance by rail from a seaport, and with the price of fuel oil consequently much higher, the works cost was rather higher than the British average. Owing to the poor nature of the coal available and to the average distance of the collieries it would appear that heavy oil engines have a very promising future in India.

As a result of the discussion on the subject, the committee proposes to complete its report and to issue it shortly in printed form.

The Corporation of Sheffield has ordered an aerial ropeway installation, a mile and a-half in length, for the purpose of conveying boiler ashes from a new electric power generating station situated at Meadow Hall. The engineer of the Corporation estimates that when the electric plant is running constantly and the trade of the city is normal, the cost of the ropeway will be earned in about five years. He states that the use of a similar means to remove ashes at another power station in the city effected in five years a saving of nearly £20,000 upon the cost that would have been incurred by other methods of transport.

The technical administrators of the telephone systems of the Western European countries held a preliminary meeting at Paris on the 12th inst., under the presidency of the Under-Secretary for Posts and Telegraphs, Great Britain being represented by Major T. F. Purves, Engineer-in-Chief of the General Post Office, and Messrs. Hill, Hart and Crayfoot. The meeting will consider a number of purely technical questiins, and prepare the way for the later meeting of an International Commission representing all the nations of Europe, which will study the question of international telephony from every point of view.

THE CANADIAN NATIONAL RAILWAYS.

SIR HENRY THORNTON, President of the Canadian National Railways, has decided that the system, including the Canadian Government Merchant Marine, shall hereafter provide for its own insurance. It is officially estimated that this will effect over a period of ten years an annual saving of 1,000,000 dollars. The insurance carried by the system aggregates upwards of 400,000,000 dollars, representing an annual premium of about 4,000,000 dollars, and the profits to the insurance companies have been large, reading as high as nearly 30 per cent. A cash reserve in the nature of a sinking fund will be established to take care of all the properties of the system. The business will be in charge of W. D. Robb in Montreal, and the financial part of the plan will be under the direction of Major Graham A. Bell, Vice-president in charge of finance.

The Canadian National Railway system has been divided into three regions for operating purposes and general managers appointed as follows:—Atlantic region, L. S. Brown, with headquarters at Moncton, N.B.; central region, C. G. Bowker, with headquarters at Toronto; western region, A. E. Warren, with headquarters at Winnipeg.

Other recent appointments are as follows:—J. E. Dalrymple, formerly Vice-president of the Grand Trunk and Grand Trunk Pacific Railways, to be Vice-president in charge of traffic; C. B. Brown to be chief engineer of the operating department; C. S. Gzowski to be chief engineer of the construction department.

THE MACHINE TOOL TRADES' ASSOCIATION.

THE annual meeting and dinner of the Machine Tool Trades' Association was held at the Trocadero, London, on Wednesday afternoon and evening. The Association now numbers 135 firms. It continues to assist its members in a large variety of ways, not only in protecting them against the undesirable promotion of exhibitions—its original prime object—but in a multitude of minor affairs, including the clearing up of debts due from enemy countries and Government Departments, reporting on trade conditions in foreign countries, and making representations on the matters of the disposal of the Government's surplus machine tools, the railway classification of machine tools, and the extension of the provisions of the Safeguarding of Industries Act, 1921, to the machine tool industry. The Association is promoting a machine tool exhibition to be held next year, but, as previously announced, is not giving its support to the British Empire Exhibition. The annual dinner was presided over by Sir Alfred Herbert, president of the Association, and was attended by about 130 members and guests, including Baron Hayashi, the Japanese Ambassador; Sir Philip Lloyd-Greame, President of the Board of Trade; Sir Joseph Cook, High Commissioner for Australia; Mr. J. T. Brownlie, President of the Amalgamated Engineering Union; Lieut.-Colonel J. A. Cole, President of the Society of Motor Manufacturers and Traders; and Sir Halford J. Mackinder.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

WHAT DO EMPLOYERS WANT?

SIR,—I sympathise with your correspondent "A.M. Inst. C.E.," whose letter you published in your issue of the 9th, being in a similar position, and I am sure that others on the "unemployed list" would be grateful if employers were to announce in the same journal in which their advertisement had appeared when the position had been filled, as there is always a certain amount of satisfaction in knowing that a matter is definitely closed, and if you will favour me by publishing this letter I would appeal to employers to make a practice of doing so. It appears to me that they often overlook the fact that the obligation is not entirely on the part of the applicant, but that it is a mutual affair.

The point raised by your correspondent regarding salary is an interesting and rather difficult one at the present juncture. It is generally said that a man's value is that which he himself places on his services, but I suggest that in such abnormal times of trade depression as we are at present passing through the case is rather different. I myself feel that one should realise employers' difficulties, and that they are compelled to look closely into every item of expenditure, salaries included. Therefore it seems to me that if a man like myself, who has been "resting" for even longer than "A.M. Inst. C.E.," takes this into consideration, the employer should understand the reason which leads him to do so, and not imagine, as I believe is the common view, that because a man of ripe experience asks a moderate salary he is desperate.

Again, in this respect individual applicants differ, not only as regards the psychological aspect of the matter, but also the material. Of two men of equal qualifications, who have arrived at a "certain age," as the French say, one, like myself, may be a bachelor, the other a married man with heavy family responsibilities and expenses. Do employers ever consider this in connection with the salary asked?

Another point I would like to make is that, in my opinion, employers do not, generally, give sufficient data regarding the vacancy in their advertisements, such as the size and location (approximate) of the factory, the number of workpeople employed, &c., as if fuller information were given it would often, I feel sure, prevent men writing applications for posts they are unlikely to obtain, either because their professional status is higher than that required and the salary asked greater than the position carries, or the reverse.

You will, I hope, excuse the length of this letter and find space for it, as it does seem to me that anything that can be done (with little trouble and at small expense) to make things easier for the numerous members of our profession who are at present disengaged should be done. I would like to say, in conclusion, that I feel sure it is merely the failure to realise the other fellow's point of view that so often makes employers rather remiss in this respect.

M.I. MECH. E.

March 10th.

SIR,—In common, no doubt, with others, I have fellow feeling with "A.M. Inst. C.E." in his complaint published in your current issue. Whilst one admits that under present circumstances, when the replies to advertisements run into hundreds, an acknowledgment to each would involve a considerable amount of work, it would appear only common courtesy to thank applicants by an advertisement in the newspaper in which the original notice appeared.

Since my demobilisation over three years ago I have replied to several advertisements which appeared to be of posts for which I was exactly fitted. I have had a few replies and requests for interviews, but have not been able to get hold of any of these berths, and from my own observation and by comparing notes with others as well as following up and finding out to whom the jobs have gone, have come to the following conclusions:—

Answering advertisements relating to posts other than public appointments seems to be of the nature of a guessing competition with the firm's name, place of business, and the salary unknown, added to which the exact position to be filled is generally very vaguely stated.

In a considerable number of cases the employer wants a certain man, and wants him to come rather than go to him, and inserts an advertisement for that man. If he replies, the rest of the replies are hardly glanced at, and the concern have got their man without having put themselves under an obligation to him.

I have also come across a case where the advertising for a man was simply used to bluff a man already in the position, but who was being rather troublesome as his war bonus was stopped. In this case I was told by letter that it had been decided not to make a change but that they "would keep my letter before them, &c.," apparently to be a sort of bogey to their employee.

I think, however, that the worst case of all is when, after giving full particulars and salary required, one is asked to call. After taking a long journey one is told that the advertised berth has been filled, but that they can offer some small job at a minute salary, and refuse to pay expenses for attending the interview. This, I find, is becoming common. Of course, in the absence of any statements to the contrary these dodges are legitimate, but appear rather beneath the dignity of what one likes to regard as an honourable profession.

With considerable experience I am bound to say that although in the U.S.A. an employer requires far more work from his assistants, they are treated with far greater courtesy than is the case generally in this country, although there are exceptions on both sides.

R. P.

Glasgow, March 12th.

TWENTY YEARS OF DIESEL ENGINE BUILDING.

SIR,—In reference to the paper by Commander Le Mesurier on the development of the Sulzer engine appearing in your issue of January 26th, we would like to call the attention of your readers to the great reduction in weight, length and capital cost which can be obtained by reducing the normal working pressure of 500 lb. of the Diesel engine to 200 lb.

Referring to the design of a marine engine comprising four units of 10,000 shaft horse-power proposed for naval work, but also suitable for large passenger vessels, the following table gives a comparison of weight and length of crank shaft of (1) the Sulzer engine as proposed in the paper, (2) an engine of the same shaft horse-power but with a working pressure of 200 lb. per square inch in place of the 500 lb. of the Sulzer engine, and (3) an engine of 200 lb. working pressure but with six cranks instead of eight. The indicated horse-power, stroke, revolutions per minute, bearing pressures, mean turning moment, and crank shaft stresses are the same in all cases.

Comparison of Crank Shafts.

Initial pressure, lb.	500	200	200
Number of cranks	8	8	6
Stroke, in.	43½	43½	43½
Revolutions per min.	170	170	170
Indicated horse-power	12,400	12,400	12,400
Diameter of cylinder, in.	33½	42	48½
Mean pressure, lb. per sq. in.	94½	60	60
Initial load, lb.	440,700	278,000	367,000
Pressure on crank pins, lb. per sq. in.	800	800	800
Pressure on main bearings, lb. per sq. in.	300	300	300
Mean turning moment, in.-lb.	4,600,000	4,600,000	4,600,000
Maximum turning moment, in.-lb.	5,050,000	5,050,000	5,750,000
Bending moment, in.-lb.	5,950,000	3,080,000	4,480,000
Combined moment, in.-lb.	13,743,000	8,980,000	10,901,000
Stress, lb. per sq. in.	6,900	6,900	6,900
Diameter of shaft, in.	21½	18½	20
Relative weight	100	67	63
Length of engine	82ft.	63ft. 4in.	49ft. 3in.

By reducing the pressure to 200 lb. it will be seen that 2½in. can be taken off the diameter of the shaft and 33 per cent. off the weight, and by using six cranks instead of eight, the length of the engine can be more than halved. This should be a great advantage in the case of an engine for naval work, and the saving of weight and space would easily counterbalance the increased fuel consumption. The reduction of weight applies not only to the crank shaft, the most expensive item of the engine, but also to the whole of the engine, owing to the reduction in the working pressure.

In the case of the mercantile engine the great advantage is in the reduction of capital cost. By increasing the stroke a few inches and decreasing the revolutions a built crank shaft becomes quite practical, and will still further reduce the cost of the shaft. Against the saving in weight, space, and cost has to be placed an increase in the cost of fuel, due to the lower pressure. This amounts to 5½ per cent., and is the reduction in thermal efficiency alone. No account is taken of increased mechanical efficiency, and any gain there may be owing to the injection air being compressed to 300 lb. instead of 600 lb. The interest on the capital cost saved largely exceeds the increased cost of the fuel. The correct ignition temperature with only 200 lb. compression is obtained by preheating the scavenging air about 160 deg. Fah. by means of the exhaust gases. With this preheat the same temperature is obtained by compressing to 200 lb. as is obtained by compressing to 500 lb. from atmospheric temperature.

CUMMINS SYNDICATE, LIMITED,
HAROLD J. ANDERSON, Secretary.

Glasgow, March 9th.

A REVIEW OF MARINE DIESEL ENGINES.

SIR,—In the recent extracts you published from the above paper, read before the North-East Coast Institution of Engineers and Shipbuilders on January 12th, it appears, under the heading of the Armstrong-Sulzer engine, that the fuel consumed for all purposes amounts to .512 lb. per brake horse-power per hour. The text does not make it quite clear that this refers to the fuel not only used by the main engine but also by a steam boiler used for driving all the auxiliary machinery. We should like to point out that this consumption appears to be excessive, and the correct figure for an installation in which the auxiliaries are electrically driven by means of auxiliary Diesel engines would not amount to more than .42–.44 lb. per brake horse-power per hour.

As reference has been made to this from several quarters we should feel much obliged if you would kindly publish in your next issue a statement on the above lines, and should there be any further information you require, we shall be pleased to let you have it.

FOR SULZER BROS.,
L. LE MESURIER.

London, March 12th.

THE CYCLIC IRREGULARITY OF GAS ENGINES.

SIR,—I have read Mr. Pardoe's letter in your issue of March 2nd with much interest. The example worked out in my book, "The Internal Combustion Engine" (fourth edition), p. 102, applies to cases in which the constant therein given has a particular value, corresponding actually to a single-cylinder two-stroke engine, or a two-cylinder four-stroke engine. I am glad to see from the postscript to Mr. Pardoe's letter that his final calculation agrees with mine. I have no doubt as to the accuracy of the result, but workers in this field need to bear in mind that somewhat different results are obtainable if the acceleration of the fly-wheel is assumed to follow a linear law instead of a sinusoidal one.

H. E. WIMPERIS.

London, March 9th.

LATHE TOOL RESEARCH.

SIR,—In your report of my remarks on the report of the Lathe Tool Research Committee, my cube law of cutting speeds was given as $V^3 a t = C$. It should, of course be $V^3 a t = C$ where V is the cutting speed, a the area of the cut, and t the thickness of the chip, and C a constant. In most of the cutting operations done in the workshop, the depth of cut is much greater than the traverse, and under these circumstances t may be taken to represent the traverse, which would be proportional to the thickness of the chip.

EDWARD G. HERBERT.

Manchester, March 8th.

Catalogues.

BOULTON AND PAUL, Limited, Norwich.—A copy of the report on tests of Boulton water elevators with Caruelle patent bands.

T. BROADBENT AND SONS, Limited, Huddersfield.—The fourth edition of centrifugal clutch catalogue. These automatic centrifugal clutches are designed to ensure easy starting of any type of motor under full load.

K. HOLST AND CO., 1, Victoria-street, S.W. 1.—Bulletin No. 2 on the ferro-concrete footbridge, built for the Sheffield Corporation, which crosses the Great Central Railway main lines and sidings.

BAKERS (LEEDS), Limited, Union Works, Saynar-road, Hunslet, Leeds.—Illustrated catalogue on the Baker patent oil separator for exhaust steam. Much useful information is included in the catalogue.

GWYNNES, Limited, Hammersmith, W. 6.—List L 595 on "Invincible" ball joints, a standardised and interchangeable joint for water, oil, petrol, steam or compressed air, suitable for pressure or suction. Catalogue No. 86 devoted to Gwynnes' "Invincible" single-inlet centrifugal pumps.

GLENFIELD AND KENNEDY, Limited, of Kilmarnock.—The 1923 edition of this firm's catalogue dealing with all sorts of valves, meters, hydrants, sluices, pipes and so forth connected with waterworks engineering. Fire-fighting appliances, hydraulic engines, small fittings and tools are also included.

JAMES GOLDER, 10–12, Broad-street-avenue, E.C. 2.—A copy of the catalogue of Alex. Chaplin and Co., Limited, Govan, Glasgow, on cranes of all types; also winding and hauling engines. A catalogue illustrating the Terry turbine, which is manufactured by the Terry Steam Turbine Company, Hartford, Conn.

ENGINEERING AND LIGHTING EQUIPMENT COMPANY, Limited, Sphere Works, St. Albans, Herts.—Leaflet entitled "An Explanation and a Reason" why the Anti-break electric lamp economiser overcomes the problem of vibration and shock; also leaflets on half-watt lanterns, and illustrated selection of ship and shipyard fittings.

SIEMENS BROTHERS AND CO., Limited, London.—Catalogue containing information concerning telephones and accessories, and also dealing with fire alarm systems, power plant for telephone exchanges, vacuum arresters, central battery telephone exchanges, and automatic telephone exchanges for public and private use.

ALEXANDER WRIGHT AND CO., Limited, 1, Westminster Palace-gardens, S.W. 1.—A selection of leaflets of various boiler-house appliances, such as CO_2 recorders, "Precision" water meters, Simmance patent dead-beat draught and pressure recorders and indicators, recording and indicating pyrometers, encased thermometers.

TRAFFORD PARK ESTATES, Limited, Trafford Park, Manchester.—A copy of a new book descriptive of the facilities offered by Trafford Park as an industrial site by the port of Manchester warehouses for storage of merchandise, by the Trafford Park cold storage for storage of meat and perishable produce, and by the port of Manchester road service for the movement of traffic by road.

Mechanically Operated Winches on a Motor Ship.

THE problem of choosing the most economical type of deck machinery for a motor ship is one which admits of more than one solution, depending on the various factors which must be taken into account. While it is true that in many cases the electric winch—despite its high initial cost—has been successfully employed, something remains to be said for the ordinary type of winch operated by mechanical means. A winch arrangement which embodies some new features is that introduced and patented by the Werkspoor Company, of Amsterdam, and first installed on the motor ship Rhea, built for the Royal Netherlands Line in Amsterdam for Mediterranean and Baltic trade. The hull of the ship was constructed by Gebr Bodewes in Lobith, and she is a single-screw vessel propelled by a 1100 indicated horse-power Werkspoor four-stroke cycle engine. A view of the main engine is reproduced in Fig. 7. The leading dimensions of the Rhea are as follows:—Overall length, 276ft.; breadth, 39ft.; moulded depth, 18ft.; with a displacement of 3500 tons and a deadweight capacity of 2250 tons.

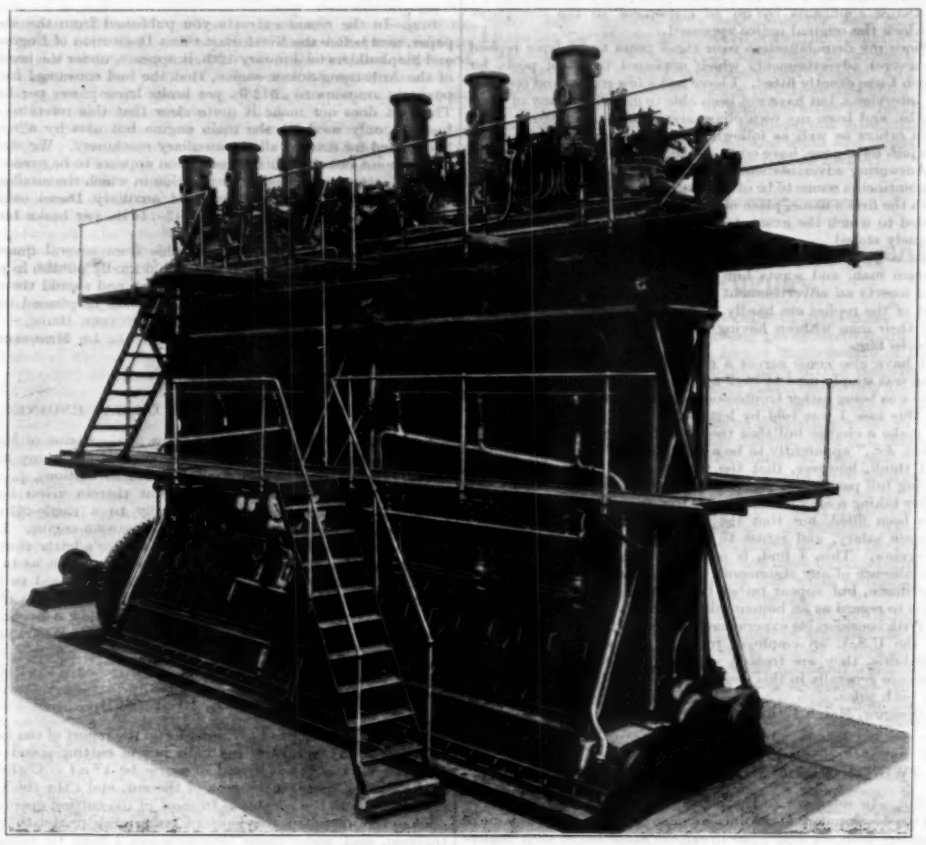


FIG. 7—1100-H.P. MAIN ENGINES OF THE RHEA

The main interest in this ship centres around the deck machinery, illustrated by Fig. 8. The nine 5-ton winches and the anchor windlass, views of which are shown in Figs. 1 to 6, on page 288, are driven by a new mechanical arrangement. In place of the usual deck steam pipes a revolving shaft runs the entire length of the deck. The shaft is supported on bearings lubricated by grease cups, and, where necessary, expansion and universal couplings are provided. At each set of winches there is a transverse shaft driven by bevel gearing enclosed in an oil-tight casing. Each winch is driven from the transverse shaft through a friction coupling which is carried between the winch frames, except in the case of the anchor windlass, when it forms part of the longitudinal shaft. A friction coupling and its hand control gear is illustrated in Fig. 5. Within the horizontal coupling casing is a series of alternate brass and lignum vitæ bearing surfaces, which are pressed together by the control gear. In order to maintain an even coefficient of friction the entire system is enclosed in a water-tight cast iron box, which is flooded with salt water, that also serves as a cooling medium. There is a reversing mechanism in the coupling which enables power to be re-transmitted to the shaft when lowering a load, thus effecting a saving in power. The load may be lowered in the usual way by means of a foot brake, but means are provided to prevent the speed exceeding that of the revolving shaft. On this particular ship the main shaft is driven by a uniflow steam engine placed in the engine-room and running at 220 revolutions per minute. The steam required for the engine and for other steam auxiliaries is raised in two donkey boilers arranged for heating, either with the exhaust gases or by auxiliary oil burners. When the vessel is at sea the heat from the exhaust gases provides sufficient steam for operating the steam steering gear, but for handling the cargo in port the oil burners are used. In later installations it is proposed to drive the main winch shaft by an auxiliary Diesel engine, which should give even more economical results, and the amount of fuel consumed when running the winches is expected to be equal or lower than that obtained with electric winches at a much lower capital cost. The reports received from the Rhea during the first three voyages show that the new arrangement has worked satisfactorily and may be easily handled by unskilled labourers in foreign ports.

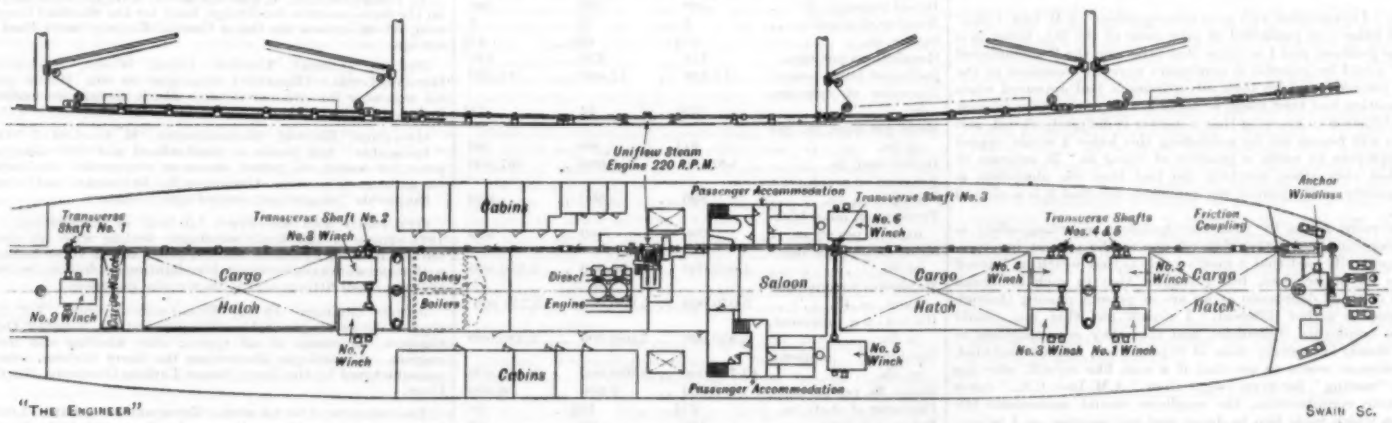


FIG. 8—GENERAL ARRANGEMENT OF DECK MACHINERY

Patent Matters of 1922.

DURING the year 1922, contrary to the expectation of many people, the number of patent applications lodged at the Patent Office exceeded those of any previous year, with the exception of 1920, a special reason applying to that year. The figure for 1913, the last full year before the war, is 30,102, and that for 1922 is 35,512. For purposes of comparison one may note that the number of applications lodged in 1920, the year in which the large influx of foreign applications occurred, was 36,680, and for 1921 the corresponding figure was 35,163. The increase in number is probably due to better trade conditions, of which conditions it is well known that the rate of filing patent applications is a good and sensitive indication. As usual, applications were lodged approximately at a uniform rate during the year.

During the year many patent, design and trade-mark cases were heard in the Law Courts. The only trade-mark application of interest to engineers related to Sun Brand varnishes, but most of the patent cases deal with engineering matters. The Austin Motor Company's patent for lubricating devices for motor cars was extended for the full period of the war, namely, four years and three months from the date of expiration. The British Thomson-Houston Company's patent for composite leading-in wires for electric lamps covering copper coated nickel iron wire and the like was upheld and its infringement by another company proved. The same company's patent for gas-filled lamps, which became the subject of litigation during the preceding year, reached the House of Lords, and was unanimously upheld, the decisions of the Court of First Instance and the Court of Appeal being thus reversed. It was held that the novelty of the invention in this case was not merely in the size of the filament, but that the inventor had discovered and utilised a new principle and had shown practical methods embodying it and putting it into operation in the combination which he claimed.

Higginson's patent for the well-known carburetter arrangement was also upheld, the technical arguments in the case providing several points of interest.

Schoop's patents, dealing with the welding of aluminium by means of fluxes involving alkali chlorides and sometimes fluorides, were reviewed by the House of Lords and upheld.

Among the several patents on which adverse decisions were given in the courts may be noted those of Clorius, Ellison, and Wallace. The last two contain much interesting information, the former with reference to gravity clocks and the latter on the subject of removing digested material from digesters.

Coleman's patent for an anti-skid device was extended for three years and six months, and extensions of patent rights were also given by the courts in respect of Crighton's patent for wringer stands, Drew's patent for motor cycle spring forks, the Duncan patents for matrix-cutting machines and cutter-grinding machines, and the Fullagar engine patents.

Extensions were also granted of the terms of several other patents, namely, Howatt's patents for mineral washing and separating apparatus, Hunt's patents for cascade arrangements of electric motors, the Johnson patents relating to electrical insulating compositions, Renard's patents for power looms for the manufacture of Oriental and like carpets, Smith's fire alarm patent, du Rhone's patent relating to the charging of vessels with anæsthetics, and the Summers Brown patents for type founts and composing sticks.

Manufacturers interested in the arts referred to in these cases should be careful to note the extensions if they have in mind the manufacture of apparatus or the carrying into effect of processes which might have been no longer protected had not the extensions been granted.

CONTRACTS.

YARROW AND CO., Limited, inform us that they have just secured a contract for a number of large water-tube boilers forming part of the boiler equipment of the new Barking power station of the County of London Electric Supply Company, Limited.

SIR W. G. ARMSTRONG WHITWORTH AND CO., Limited, have received through their Lisbon agents, Monteiro Gomes Limitada an order for twelve locomotives of the 4–8–0 superheater type, with double bogie tenders for the Loanda State Railways of Angola, Portuguese West Africa.

THE BRADLEY PULVERIZER COMPANY, of 37, Walbrook, London, E.C. 4, has just received from Burnyeat, Brown and Co., Limited, Abergorky Colliery, Treorky, South Wales, an order for a 30in. Griffin mill, to be used for grinding colliery shale for the prevention of explosions in mines. This is a repeat order. The same company has also just delivered a Bradley three-roll mill to Mr. Robert Mitchell for installation at his Craighead Lime Works, Killochan, where it is to be used for grinding hard limestone.

DANIEL ADAMSON AND CO., Limited, engineering works, Dukinfield, Manchester, have received from the War Office an order for six large automatic sewage ejectors for Cairo. The same firm has also received an order from the Municipal Council of Port Elizabeth for the supply, delivery and erection of a complete pneumatic sewage ejector equipment for the main sewerage area 7a, comprising electric motors, air compressors, switchgear, air and rising mains and ejectors of their patent "Floatswitch" type.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Staffordshire Marked Bar Prices Advanced.

STAFFORDSHIRE marked bars, the price of which for nearly twelve months past has stood at £13 10s., have this week been advanced 10s. per ton to £14. Since December last other qualities of finished iron have been rapidly advancing in price, and it has occasioned some surprise that makers of best bar iron have so long delayed taking what has been regarded for weeks past as an inevitable course. The balance of the market had to be maintained, and though some makers were for sticking to the late standard of £13 10s., the market was surprised that the advance was not one of 20s. instead of 10s. Finished bars of merchant quality and bars for nut and bolt making continue to appreciate, and some Staffordshire houses are now quoting £12 10s. for best Crown bars, putting them on a level with the Lancashire and South Yorkshire trade. This is an advance of something like 10s. per ton on last week's quotations. Some makers are prepared to accept 5s. less, however. The larger requirements of the wagon building industry have given a fillip to demand. Nut and bolt bars are also up nearly 10s. per ton, being quoted this week at £11 10s. Lancashire firms have put up their price to £11 15s. The effect is being felt in regard to new orders for the finished product, which are not coming along as fast as old ones are being worked off. Manufacturers who are disappointed of Belgian material on which they had depended to keep plants employed have no choice but to make good the deficiency from home sources. There is little or nothing coming from the Continent to relieve the situation, but, naturally, users are buying sparingly. Mills devoted to steel re-rolling are busy, a good deal of material being called for on foreign, chiefly German, account. Iron strip continues to appreciate and is now commanding £12 minimum. Galvanised sheets have reacted to some extent. It is possible to do business at £19 5s., and even lower prices are mentioned. But many makers still quote £19 10s.

Effects of the Raw Iron Scarcity.

It is almost impossible to buy Midland pig iron for immediate requirements, and in some cases it is stated steel makers are feeding their furnaces with broken cast iron and almost any material available. Puddling furnaces are being brought to a standstill in South Staffordshire and producers of finished iron and steel are in danger of "missing the tide." Even at the extravagant prices now ruling there is a strong demand, but supplies are shorter than ever. Some makers, especially of Northamptonshire and North Staffordshire irons, have nothing to sell, and there is no prospect of immediate relief. Pig iron can be obtained only in driblets at fancy prices. The shortage of raw material is curtailing the output of finished material. Apart from the small lots which are allocated to regular customers, there is no Northamptonshire pig to be got this side June. Quotations for June delivery in some cases are 95s. for forge and 105s. for No. 3 foundry. The facilities offered for forward contracting are very limited, however. Derbyshire and North Staffordshire furnaces have put up their prices for prompt business in foundry irons 5s. per ton. As regards forge iron, famine conditions really exist. The position largely hinges on fuel, and furnaces are not likely to be lit until it is cheaper and more plentiful. There is a good deal of sympathy with the demand by the Wolverhampton Chamber of Commerce that the Government should stop exports of coke in the interests of British trade. Large numbers of furnaces in this district would be started up at once if the requisite coke were obtainable at a moderate price. The latest quotation to local blast-furnaces was £1 17s. 6d. at the coke ovens, an impossible price, quite apart from the fact that there is no guarantee of delivery whatever price is quoted.

The Coke Position.

The scramble for coke continues, and while there are many blast-furnaces in the Midlands, in common with other parts of the country, starving for want of it, large tonnages are being shipped daily to competitors overseas. The matter is compelling serious attention, and it is suggested that there should be a round table conference between the coke producers and the users, in order to see whether any arrangement might be come to. There are, however, many in close touch with the industries who are sceptical of any definite results from such a meeting. In other quarters opinion is expressed that the Government should take steps to prevent the export of this vital commodity. Mr. F. C. Ryland, president of the Birmingham Exchange, at the annual meeting last week, said it was a calamity that, with a largely increased demand for pig iron, the material necessary for its production was not available. The present difficulty had its origin in the coal strike of 1921, because, as a result of that strike, only a moderate proportion of ovens had been working, and with so little profit as to offer no inducement to makers to extend their operations. Before the present position in the Ruhr came about there was the usual export demand, but now the demand was large and insistent and at prices which makers who had passed through a very lean time felt they must take advantage of. Speaking on behalf of South Wales, he was pleased to say there were makers who realised the value of the home trade and the consideration due to their customers. Those makers were sacrificing large present profits in order to maintain reasonable supplies, and when he said that up to 85s. per ton f.o.b. for foundry coke had been paid the force of his remarks would be appreciated. While he felt it was better to be without Government control, he regretted the abandonment of the export duty, as it was obvious the foreigner could afford to pay it.

Constructional Steel in Demand.

All classes of steel continue to be called for in large quantities, and prices of both finished and semi-finished material are strong. There are signs that the steel masters are approaching each other to secure a uniform price, as there have been many complaints of "cutting" during recent weeks. Constructional business is generally expanding, but there is a good deal of uneasiness, in view of the artificial conditions, which it is believed must soon have a restrictive effect upon new work. Makers are disposed to insist more strongly than usual upon time conditions, requiring customers to take deliveries within a specified time. Constructional steel is about £2 per ton dearer than it was in December. Bridge plates at date at Staffordshire works are quoted £10 10s. upwards, angles and joists £10, and boiler plates £13 10s. Engineering and other contractors who have to go on the market for their raw material cannot foresee what the position may be when the supplies which they have bought are used up. Present price levels are unacceptable as a basis of forward business. It is widely felt that the only safe thing is to stand still while the commotion subsides. Semi-finished steel is in great demand, but there has been no definite displacement of the values ruling last week, though sellers ask something more than the basis rates which nominally apply. A well-known Welsh firm is quoting £8 10s. at works, equal to £9 5s. delivered. Midland steel works offer material at prices ranging from £9 10s. to £10 10s. Now that the American exchange is practically normal, inquiries for heavy lots are being directed to the United States. Among others, consignments of gas strip for tube making are the subject of inquiry. There are no quotations for foreign steel, but a lot of semi-finished material has yet to be delivered on old contracts. Wire rods are dearer by 20s. per ton, and most descriptions of finished wire have moved up in sympathy, the basis for bright round mild steel wire now being £21 a ton in hundredweight and half-hundredweight coils.

Rolling Stock Orders.

Rolling stock business continues to improve, though most of the home railways have not yet completed their arrangements for bringing their stock up to normal requirements. In connection with the steps which have been taken in this direction by the London and North-Eastern Railway, two Birmingham wagon building firms have received substantial orders which will provide employment probably through the spring and summer. The share given to the Midland Railway Carriage and Wagon Company is just over a thousand wagons, while the Metropolitan Carriage, Wagon and Finance Company has an order for 800. These contracts are regarded as the beginning by the home railways of the task of increasing their carrying capacity. Substantial contracts for both goods and passenger vehicles will be necessary, and with more favourable conditions in regard to raw materials rolling stock makers believe that many of these will be released during the next few months.

West Bromwich Electricity Extensions.

The increasing demand for electricity at West Bromwich has induced the Electricity Committee to bring forward a scheme for extending the generating plant. The Committee recommends the purchase of certain plant from the Disposals Board. The total cost of the extensions will be £33,500, compared with the estimate of £67,000 approved by the Council some years ago. The work was not then carried out, as the slump came and demand diminished to such an extent as to render the extensions unnecessary.

New Miners' Union.

The new miners' union which is being formed by Nottingham and Derbyshire miners to counteract socialistic principles, to which I referred in my letter a fortnight ago, is now taking definite shape. Delegates from pits in the Midland area met at Mansfield on Saturday last and approved the rules of the new Industrial Protection Union. Politics are rigorously excluded, and no man belonging to a revolutionary body such as the communist party and the Industrial Workers of the World will be eligible for membership.

Fewer Idle Hands.

The unemployment returns for the West Midlands area again show a substantial reduction on the week. The figures compiled up to February 26th, as recorded in this letter last week, showed there were 146,261 persons registered at the various labour exchanges as unemployed, which was a decrease of 4306 on the previous week. Returns made up to March 5th show there has been a further reduction of 2535, the total falling to 143,726. In Birmingham the number is about 600 fewer than last week and the figure now stands at 48,059. At Coventry the latest return shows 4318 unemployed, as compared with 4439 a week earlier.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

THERE has been some further upward movement in prices, both in ferrous and non-ferrous metals, since I last wrote, but one cannot say that it has been caused, or even accompanied by, a corresponding increase of business. On the other hand, so far as Manchester is concerned, there would appear to be some falling off in the actual amount of new business passing; and this circumstance is very peculiar. When business falls off we should see a weakening in prices, and if, as in the present case, we do not, there must be something very unusual in the position. There are people who say that the advancing markets are checking business, but the experience of most people is that rising markets promote buying, and that when the prices have reached the top and begin to fall it is then that buying is checked. One cannot help thinking that the general position in the iron and metal trades is very unnatural and artificial, not to say dangerous.

Metals.

With the exception of tin there has not been any serious change in the markets for non-ferrous metals since last week. Copper has fluctuated a little, but the feeling has been quieter, and possibly we are now going to have a more settled market at or near the higher level which has been reached. No one can say that this higher level is at all extravagant; and in relation to all the other sections of the metal market it is still low. Iron, lead and spelter are all at nearly double the normal pre-war levels; while copper, nickel and aluminium are at moderate pre-war prices. With regard to the immediate future of copper prices, if it be true that the present wave of buying in America is over for the time, some reaction may take place. The higher prices obtained there will probably stimulate production; and although American consumption is quite good, one doubts whether the world is yet in a condition to absorb very much copper. In Manchester there has perhaps been a little more buying by consumers as a result of the scare set up by the advance, but engineers here are not very anxious to buy copper or its alloys, or otherwise we should see more activity in the market for scrap metals. For instance, when one talks to dealers in scrap one finds that they are not anxious to buy good gun-metal at £48 or £49 per ton; although refined copper is at £76 and tin at £225, and the lowest cost at which any gun-metal could be mixed is about £80 per ton. So soon as there is really good trade and not only anticipation of good trade, we shall see the prices for scrap put into proper relationship with the prices for new material. When this occurs the reader may believe that a real revival of trade is taking place. To sober-minded people the upward movement in tin seems to have gone quite far enough. So little has been said lately about the reserve stocks of tin in the East, particularly those under control of the F.M.S., that some people seem to have forgotten that these stocks still exist, and are waiting a favourable opportunity for liquidation. Whether present prices will be considered favourable remains to be seen, but it is well to remember that the stocks are there. The market for lead remains very firm, and one does not see yet any prospect of lower prices. Buyers, however, are cautious and inclined to take as little as possible. Spelter has been slightly easier, partly because some German spelter has recently been sold. The demand from consumers lately has been only moderate.

Pig Iron.

The market for foundry iron in Manchester is very firm, and it is not quite easy to say what the price is. Both buyers and sellers seem inclined to hold off and transactions are not very numerous. The time must soon come when ironfounders will be compelled to renew their supplies, and it is not at all clear that they are going to gain much by waiting. Every effort is being made to increase the output of foundry iron, but one does not hear that very much progress is being made, and a large quantity of iron is still going abroad. Consumers in Holland and Scandinavia are now obliged to depend mainly on British supplies, and the scarcity of iron for home use is very obvious. It would seem that Manchester consumers, when they come into the market, will have to reckon, as a basis, upon 110s. per ton at the Midland furnaces, which will mean about 118s. 6d. delivered in Manchester. This figure has not been paid yet, and probably about 115s. is about the highest; but Midland makers do not seem at all eager to book far ahead at 105s. or even 107s. 6d. per ton at the furnaces, although this price, even under present costs, ought to leave a good profit. The fact that up to 125s. per ton is paid in the North-East for No. 3 Cleveland iron makes them nervous.

Finished Material.

The demand here for Lancashire manufactured iron is clearly better than it was, and there would seem to be some chance of a return to full employment at the Lancashire ironworks. If this should happen bar iron making will again become a very profitable industry; for it is only the very partial operation of the ironworks which has necessitated the present price of £12 10s. for Crown bars. Some steel sellers are inclined to think that the actual demand for manufactured steel is not quite so good as it was, but the works for which Manchester buys are fairly well off for orders now and rather stiff in their prices. Round bar steel is quoted up to £11 per ton, and common plates from £11 to £11 10s. Sections are rather cheaper, but the quotations vary a good deal, and seem to depend more upon whether the seller is in need of orders than upon anything else.

Scrap.

The position in the scrap trade is still improving, but of course there is plenty of room for improvement here, more particularly in regard to foundry scrap. This material keeps comparatively low, simply because the ironfounders will not yet recognise the validity of the new pig iron prices. When they bring themselves to pay 115s. per ton for No. 3 pig, they will surely not neglect good machinery scrap at 100s.; and up to the present dealers have not succeeded in obtaining even this figure in the Manchester district. Heavy steel and heavy wrought scrap are both getting scarce, but it is difficult to say what prices would be paid for them. Dealers, however, think that at least £5 per ton should now be paid for heavy wrought scrap delivered.

Institution of Civil Engineers.

The Manchester and District Association of the Institution of Civil Engineers held its second annual dinner at the Midland Hotel, on the 7th inst., Mr. J. B. L. Meek, the president, being in the chair. Dr. Maw, the president of the Institution, was unable to be present owing to indisposition, and his place was taken by Mr. W. B. Worthington, past-president. The guests included Mr. A. S. Barnard, chairman of the North-West Centre of the Institution of Electrical Engineers; Mr. B. Mouat Jones, M.A., Principal of the Manchester College of Technology; Colonel H. T. Crook, past-president of the Manchester Association of Students; Lieut.-Colonel M. M. Bidder, president of the Yorkshire Association, Institution

of Civil Engineers; S. L. Pearce; H. H. Jeffcott, secretary Institution of Civil Engineers; H. N. Allott; C. E. Stromeyer; Alfred Saxon, and Daniel Adamson. In reply to the toast of the Institution of Civil Engineers, proposed by Mr. J. N. Gresham, student, Institution of Civil Engineers, Mr. Worthington congratulated the local association upon the success which it had achieved. Speaking as a member of Council, he said their aim must always be to hold up the end of the civil engineering profession. While congratulating the local associations on their vitality, he said that the number of members of these branches was only about one-eighth of the total membership. Lieut.-Colonel Bidder, in proposing the toast of the Manchester and District Association, however, ventured to differ from the last speaker with regard to the number of members which the local branches represented. He estimated the number at nearer one quarter of the total membership, and hoped that the Council would be always ready to listen to suggestions from the provincial bodies. Mr. Meek, in response, spoke of the difficult position of the young civil engineer at the present time, saying that no one would recommend the profession as a means of making a fortune quickly. He urged the younger men to go abroad where there were many opportunities, especially in the Argentine and Brazil. Mr. Meek said the growth of the Manchester Association was satisfactory if slow, the number of its members this year being 248 against 205 last year. The attendances at the meetings were well maintained, and students were speaking more freely in the discussions than formerly.

The Proposed Manchester-Liverpool Road.

At a meeting of the Manchester and District Town-planning Committee held recently, a decision was arrived at which will probably destroy any immediate chance of the above-named road being constructed. It was decided that a better policy would be to concentrate upon the road-making plans which the council has in contemplation or to which it is committed. It is understood that similar views are held on the part of other authorities through whose districts the road would pass. This does not necessarily imply that a new road to Liverpool may not come about, for the Town-planning Advisory Committee has in view a scheme for the future development of the Mersey and Irwell watershed area—a district covering about 800 square miles, and extending from Rawtenstall on the North to Macclesfield on the South, and from Tintwistle on the East to Warrington on the West.

Manchester Association of Engineers.

A paper entitled "Carbon in Cast Iron," was read before the above-named institution on Friday, March 9th, by Mr. E. Adamson, Sheffield. He said he had come to the conclusion that there was less known respecting the true influence of carbon in pig iron and cast iron than any other impurity, owing to the common belief that the other impurities chemically and physically control carbon, and, therefore, control its general influence on the structure of cast iron. The practical man of long experience, he said, never believed this, and he was right. There was no doubt that the structure of pig iron was primarily controlled by the temperature at which the iron was originally produced, and temperature was the important factor throughout foundry operations. Moissan's purely academic research had a very practical application to metallurgical operations in the blast-furnace and the foundry, for the crystallisation of graphite was the greatest factor in the molecular structure of cast iron, and this was influenced first by primary temperatures in smelting, and next by secondary temperatures. The paper was illustrated by a number of micrographs.

BARROW-IN-FURNESS, Thursday.

Hematite.

It is impossible to say that there is more business doing, for that would not be correct. All the works are at their full output as far as the present number of furnaces will allow, and it is impossible to put in more furnaces owing to the difficulty about coke supplies, which are only sufficient to keep the present number going. There is no margin, but it is a comfort that there are no more stoppages to report. There is a tendency on the part of makers to hesitate about booking orders for forward delivery beyond April. Coke is lifting in price, and this is affecting the cost of making iron. Both on home and continental account there is no lack of orders, and the inquiries are very considerable. America is still taking deliveries, and there was a shipment to Boston last week from Barrow. In special qualities of low phosphorus iron there is a good inquiry from the Midlands; in fact, it is doubtful as to whether there is enough to meet the demand. Ferro-manganese finds a good market, and America is taking a good quantity. There is a fair trade in ingot moulds.

Iron Ore.

The iron ore trade is busy throughout the district, but the amount of trade is well behind top figures yet. Indirectly the coke supply is interfering with the ore trade owing to the number of furnaces in blast being limited. Prices are showing an upward tendency as trade improves. More foreign ore is coming into port now, and the prices are rising under the influence of a better demand.

Steel.

The steel trade does not show the activity one would like to see. There is a certain amount of business being done, but the bulk is not great. The Workington rail mill is stopped again, but the Barrow one is still at work, and will continue to be so for some time yet. The hoop and small bar mills are kept going, and foundries are experiencing a little better business.

Shipbuilding and Engineering.

Further orders have been secured by Vickers Limited at Barrow. They have been successful in securing an order for a Donaldson liner, which is specially designed to carry freight and cattle, and the significant item about this vessel is that she will be driven by a single set of Vickers internal combustion engines developing 3000 indicated horse-power. Hitherto Vickers have installed in vessels twin sets, each of 1250 indicated horse-power, but this is the first single set. The new engine will probably have six cylinders with a long stroke. This is the first cattle-carrying vessel that will have internal combustion engines. Another order is for a cargo vessel which it is understood will be managed by the Donaldson Line, but will be owned by a London firm, and it is rumoured that she is intended for the paper trade between Newfoundland and this country. Vickers have thus five vessels on order, and there is a further prospect of more work in the early future.

SHEFFIELD.

(From our own Correspondent.)

Continued Activity in Mild Steel.

THERE is not much change to report in the condition of the Sheffield trades. Those that were doing well when I last wrote continue in the same condition, and those suffering from depression show only moderate signs of improvement. On the whole, progress is still in the right direction. The latest return from the Employment Exchange shows a drop of 500 in the number of unemployed in the city. The total, however, is still very large and exceeds 31,000. Mild steel continues to be the busiest branch, and the open-hearth furnaces are well employed. Rotherham has more of these furnaces than Sheffield, and is consequently gaining the greatest benefit from the revival. Orders for this class of material pour in rapidly, and makers are sorely put to it to furnish all the supplies that are required of them. A good proportion of the material is for export, thanks largely to Germany's difficulties in the Ruhr; but the bulk of the output is being taken by users in this country, and is providing work for the rolling mills and forges. High prices are being demanded, and are justified by the dearness and scarcity of pig iron and scrap.

Railway Material.

The home demand for steel is largely brought about by the constant flow of orders for railway material, including axles, tires, springs, and buffers. Large orders for wagons have been placed within the last week or two, and local firms are benefiting from them, even if they are not the actual contractors. The work is executed very rapidly at the large and up-to-date plants which Sheffield possesses, and there is no boom in this department. The amount of work on hand, however, is very substantial and the outlook continues to brighten, especially in regard to the Indian and South American markets. As showing the way in which trade in heavy steel has improved, a remark made by the chairman of Henry Bessemer and Co., Limited, at the annual meeting last week, may be quoted. He said they had three and a-half times as much work on hand now as they had a year ago, and more than double what they had ever had in hand since the end of 1920. This meant that both the Sheffield and Bolton establishments were reasonably well off for work. The bulk of the orders on hand are for tires and axles.

New Processes in Buffer Making.

Some of the latest and most important developments in the Sheffield steel trade have to do with the production of railway supplies, and a leading place amongst these is occupied by a new works for the manufacture of entirely weldless forged steel buffers, which George Turton, Platts and Co., Limited, have erected at Meadow Hall. The processes in operation are entirely new, devised by the firm itself, and are patented all over the world. Large hydraulic presses make weldless cases and plungers at the rate of twenty per hour, and solid heads and flanges are produced at the same rate by large heading presses. Buffer rods are made at a speed of over thirty per hour from the first handling of the long billets to the finished straightened rod, and are of such excellent finish and so true to size that machining is unnecessary. By the old methods of making buffer rods it is impossible to turn out more than eight or ten per hour. Large quantities of the Indian standard hollow plunger buffers are being made, entirely weldless, which method is fast superseding the old one of making the buffers from lap-welded tubes with flanges welded on. The works are now employed at high pressure, night and day, and necessity for extension is already being felt. Orders for many thousands of buffers are on the books for railways in this country, India, South Africa, and other parts of the world, which will keep the works fully employed for many months. The whole of the works and plant are designed for large production, on a scale never dreamed of in Sheffield before, and the firm expects shortly to reach an output of 1000 complete buffers, as well as 1000 to 2000 buffer rods, per week. In a recent tender for 13,000 complete buffers it was able to secure the contract in the face of all British, Belgian, and German competition.

The Lighter Trades.

Although the heavy steel trades are gaining by the troubles in the Ruhr, the lighter branches, devoted to crucible steel and various kinds of steel used in engineering, are being affected in the opposite way. The depreciation in the currencies of France, Belgium, and Italy, which followed the invasion of the Ruhr, has sadly interfered with the power of these countries to buy the expensive high-class steels produced in Sheffield. The volume of business in these directions has been reduced to the lowest ever known. There is a brighter side of the picture in the fact that the home demand shows a gradual recovery, and that the Colonies, India, and other countries which are not suffering from currency troubles are taking larger supplies. The trade as a whole is still very badly placed, but some makers have a fair amount of orders on hand, and the prospects are improving. There is still a great deal of slackness in the cutlery and plate trades, the only really active departments of which are stainless table knives in the former case and spoons and forks in the latter. The improvement in the scissor trade, to which I have previously referred, is maintained; but there is very little being done in pen and pocket cutlery and in razors. Experiments are being made in the use of electric welding for joining knife blades, bolsters, and tangs.

Barnsley's Water Facilities.

I have previously referred to the Rotherham Corporation's scheme for making a service reservoir at Kimberworth, to hold 3,000,000 gals. A much more important scheme—the largest which has been introduced in this district for some time—is a proposal of the Barnsley Corporation to construct a new reservoir in the Yorkshire hills above Penistone. The present reservoir of Barnsley is in the same neighbourhood, at Ingbirchworth, and has a capacity of 300,000,000 gals., with a collecting area of 1800 acres. It is now proposed to make an additional dam on the Scout Dyke in the same valley, about a mile below Ingbirchworth, with a capacity of 170,000,000 gals. and a drainage area of 780 acres. The yield of the present works is 1,725,000 gals. per day, and the new reservoir would provide a further 870,000. The Corporation is at present promoting a parliamentary Bill by which it seeks the necessary powers. With regard to the amount of compensation water to be sent down the streams, negotiations are now in progress, and an agreement is likely to be reached.

Oil-cooking at Sea.

An interesting departure in connection with the use of oil fuel on steamships has recently been made by Moorwoods, Limited, of the Harleston Ironworks, Sheffield. Anticipating that oil propulsion would be followed by a demand for oil as a substitute for coal in heating cooking ranges and appliances, this firm took the matter up thoroughly and made exhaustive experiments. These resulted in its adapting the "Kermode" system of oil firing, and it has lately received valuable orders for installations of galley ranges and equipment.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Work for the North.

THE recent feeling of insecurity regarding the trade position in the North of England is gradually passing away and giving place to something more like assurance and confidence. Industrial prospects are undoubtedly brightening. The steel works are busier than for two years past; many blast-furnaces are to be lighted up as soon as fuel supplies are available, and the shipyards are becoming increasingly active. This week several important contracts for new ships have been placed with North-East Coast shipbuilders. These include one 8000-ton motor vessel, two 4000-ton steamers, and two smaller steamers, placed by London owners with the Furness Shipbuilding Company, Limited, of Haverton Hill-on-Tees, which has also received important contracts for constructional steel for two large colonial railway companies. Armstrong, Whitworth and Co., of Newcastle, has received an order from the Swedish-American Line for the construction of a passenger vessel of 17,000 gross tonnage, capable of developing 13,500 shaft horse-power, and a speed of 17 knots. The new vessel, which will be 600ft. long and 72ft. broad, with a depth of 42ft., will be propelled by motor engines. A new type of double-acting four-cylinder engine will be used, making the vessel the largest in the world driven by motors. The vessel will be built in the Walker yard of the company.

Cleveland Iron Trade.

The position in the Cleveland pig iron trade is exceptionally strong. The scarcity of foundry iron is more pronounced than ever, and if some of the home consumers are still reluctant to pay the present high prices, there is plenty of competition for the few small lots that come on to the market, and makers are booked up with orders for months ahead. It is difficult to buy any iron for delivery before May or June, and the expanding needs of the home steel works and foundries are supplemented by such an active demand from the Continent that the scarcity is likely to continue for some time to come. Output is improving, but only slowly owing to the difficulty of securing adequate fuel supplies. A blast-furnace has been put into operation on Cleveland iron at Bolckow, Vaughan and Co.'s ironworks, and another furnace has been started on hematite at the Normanby Ironworks. There are now forty-five blast-furnaces in operation on the North-East Coast, seventeen being on hematite, thirteen on Cleveland, and fifteen on basic, ferro-manganese, &c. The price of No. 3 Cleveland pig iron is now 127s. 6d., which represents an advance of 2s. 6d. per ton on last week's figure. No. 1 is 130s., No. 4 foundry 125s., and No. 4 forge 120s.

Hematite Pig Iron.

In spite of the bigger output, East Coast hematite pig iron is even more scarce than foundry iron, but as it is relatively cheaper than foundry iron it is being used in some cases where foundry iron is usually required. The export demand is also strong. Mixed numbers are now quoted 122s. 6d. per ton, and No. 1 123s. 6d., although both figures might be shaded.

Iron-making Materials.

There is little business passing in the foreign ore trade, consumers for the most part being well stocked. Best Rubio ore is about 25s. per ton c.i.f. Tees. The coke trade is stronger than ever, and supplies just as scarce. Many furnaces will be lighted up as soon as fuel supplies are assured, but that is the difficulty, and as long as there is such a big margin between the home and export price of

coke there will be a strong inducement to sell to the foreigner to the detriment of British industry. The coke producers are, nevertheless, doing their best, and are honouring as far as possible their obligations to the iron-masters. Prices, however, are very firm, good medium furnace kinds being sold to old customers at 39s. to 40s. per ton delivered at the works.

Manufactured Iron and Steel.

A more active trade is reported in manufactured iron and steel. The export trade in particular is showing signs of revival, and whilst manufacturers are moving cautiously with regard to forward business, a number of fair orders have been booked. Costs of production are still rising, and further advances in prices are announced. There is a great scarcity of semi-steel, and a 10s. advance in soft steel billets brings the price to £10. A further rise of 20s. per ton brings the price of heavy steel rails to £10 10s., and fish-plates to £14 10s., whilst iron ship rivets are up 20s. at £14 per ton. Other quotations remain unchanged.

The Coal Trade.

The Northern coal trade position generally is acquiring more stability and regularity, and all the indications point to the probable continuance of the present strenuous and strong market for some time to come. The outlook for the next few months seems decidedly brighter, and more assured than appeared likely a short time ago. This condition is, of course, entirely due to the influx of German orders from time to time. As there is apparently no anticipation of a falling away of the extraordinary demand from that quarter, any increase in the call from other countries is bound, in the nature of things, to stiffen the position still further. The latest indications from abroad point to the lessening of the American menace. This is due, on the one hand, to the enormous demand for all classes of coal, which this country cannot possibly overtake at this juncture, and, on the other, to the rising of both the coal and freight prices for American coal by as much as a dollar per ton in some cases. The question of forward contracting is not quite so much to the fore, but negotiations are in many cases still proceeding quietly. Current prices are quoted, and are easily possible to the end of June or even further forward. Collieries, however, are by no means anxious to commit themselves very far ahead, as they hope to do rather better later on. Northumberland steam coals of every class and brand are firm, particularly steam smalls, which look like moving forward still further. There is every possibility of a big demand developing for steams, inquiries now coming to hand from the Latvian State, Finland, Sweden, Norway, Denmark and Holland. Gas coals of every description are also scarce and strong, and the collieries are so well sold that the only matter for discussion appears to be the question of arranging dates of loading, the collieries being able to dictate their own terms as to price. The coke market continues very steady and assured. All classes of foundry coke, as well as gas coke, are firm at full figures.

Cleveland Miners' Hours.

At the request of the Cleveland ironstone mine-owners, the miners' representatives have agreed to a new conference for discussing the question of longer working hours in the mines. Recently, by a ballot, the men rejected a proposal to revert to an eight-hour working day.

SCOTLAND.

(From our own Correspondent.)

Active Export Markets.

The higher costs of material have evidently had little effect on the export trade so far. Inquiries are increasing, and many orders are mentioned for which full current prices have been obtained. Contracts, moreover, are of a general description, and indicate a greater disposition towards British goods, even although the prices charged are heavier than competitive offerings.

More Work for the Clyde.

Andrew Weir and Co., managing owners of the Bank Line, have just placed an order for three cargo vessels to be built at Govan. The overhauling of the Canadian-Pacific liner Marvale—formerly the Corsican—is also booked for the upper reaches of the Clyde.

Increased Demand for Pig Iron.

The local demand for pig iron is growing in spite of the dearer prices. Foundry qualities are very busy and the output is severely taxed, and the amount available for export is exceedingly small. Hematite is receiving considerable attention. Prices generally are still firmer, but with supplies so restricted are really a matter of arrangement.

Finished Steel and Iron.

Apart from the tendency of prices to increased firmness there is no apparent change in the steel and iron trades. Orders for steel material have been fairly plentiful on both home and export account, and the various works have a fair tonnage booked. The chief demand has been for sectional material of the lighter varieties, but makers are hopeful of early orders for plates, provided costs can be kept within reasonable bounds. The export inquiry for sheets is increasing, especially for the lighter gauges. Home demands are steady, and most orders fairly plentiful. Makers are not always able to accept the business on offer, owing to previous bookings. Malleable works have a good number of orders, both for iron bars and re-rolled steel material, but the output of the latter is hampered by a scarcity of imported billets. All descriptions of scrap material are in only moderate supply, and prices are firmly held.

Coal.

There has been little if any diminution in the demand for Scotch coal for export, and the market fully retains its firmness. Practically all descriptions without exception, are heavily booked, and difficulty is experienced in arranging shipments. Collieries are almost fully booked for this month, and have heavy commitments for April, and have very little available for prompt disposal. An occasional lot is thrown on the market through a steamer falling out of position; but anything of this nature is quickly secured at full current prices or more. Considerable congestion prevails at the loading ports, especially on the Firth of Forth, where all shipping records are likely to be eclipsed. Foreign exports are well maintained. France, Belgium, and, of course, Germany are still the chief buyers, but there has been a decided increase in coastwise traffic and bunkering. Aggregate shipments amounted to 353,864 tons, against 329,041 tons in the preceding week, and 247,936 tons in the same week last year. In the home market industrial requirements are reduced to the lowest possible owing to increased costs. House coal of good quality is busy, but merchants are not always able to cover their requirements.

Lanarkshire Working Week.

Owing to the fact that many colliers in Lanarkshire have for some time been disregarding the five days per week working policy, the Union officials decided to take a vote on the matter. The result of the ballot shows a considerable majority in favour of working eleven days per fortnight. The men will, therefore, work six days this week and five days next, and so on. Of the seventy-one branches in the union fifty-five are said to have voted for the extension and only sixteen against.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

Strong conditions have been in evidence in the steam coal trade during the past week, and it would appear as if the highest point has not yet been reached. The demand from abroad still comes to hand, and as the difficulties in getting supplies for anything like prompt shipment are becoming more accentuated with each day that passes, so buyers are extending their inquiries for later delivery. It appears as if nothing short of a fresh agreement on the reparations question between France and Germany can prevent values of coals in this district from further advances. In the event of such an agreement being consummated, there is no doubt that a very different complexion would come over the market, as, notwithstanding the fact that coals have been sold to a considerable extent over the next few months and even to the end of the year, the effect would induce foreign consumers to withhold their orders in the expectation of prices weakening. Values would certainly weaken to some extent, though not appreciably for early loading. Meanwhile, collieries and exporters cannot cope with the demand which is being received mainly from Germany, Belgium, France and Italy. Business has to be turned down simply for the reason that the coals cannot be produced, let alone shipped, and for any parcels that may be picked up here and there, sellers can practically name their own prices. Best Admiralty large nowadays is in the neighbourhood of 37s. 6d. to 40s. per ton, and as regards small coals, collieries which produce the best grades can secure without difficulty 27s. 6d. and possibly 30s. Such conditions as those now prevailing were never expected a month ago, and there is no doubt that the collieries are doing well, but there is another side to the picture, and that concerns the coal-exporting firms which have taken c.i.f. risks. The position for them is not so satisfactory, as freight rates have advanced to such an extent that what at one time looked good business for them has been turned into a loss and a very substantial one at that, in many cases. In fact, the movement in the freight market during the past week has been so sharp as to make many exporters regret having sent out c.i.f. offers within twenty-four hours; while as regards the commitments entered into a month or so ago, the chances are that merchants are on the wrong side to the tune of several shillings per ton. This will be seen from the fact that it is not so very long ago that Antwerp was worth 6s., as against 8s. 6d.; West Italy, 10s. 6d., as against 14s. to 15s.; Bordeaux, 5s. 6d., as against 8s. 3d.; Marseilles, 10s., as against 14s. 6d.; Port Said, 11s. 6d., as against 15s.; River Plate, 11s. 6d., as against 18s. to 20s.; Northern Range of American ports, 7s. 6d. f.d., as against 10s. to 12s. f.d.; and Venice, 12s. 9d., as against 16s. to-day. Such advances as these in the outward freight market, while advantageous to the shipping industry, are manifestly to the financial disadvantage of merchants, who took business some time ago on the basis of the lower indications, unless, of course, they have not only covered themselves for their coal requirements but have freight contracts, which is rather the exception than the rule.

Dock Loading Hours.

Reference was made to the abortive proceedings at Cardiff last week in respect to the negotiations for a revision of the working hours at South Wales ports. The necessity for an alteration is again emphasised by the conditions prevailing, as in the early part of this week there were no less than eighty-six steamers held up at the various ports in this district waiting for loading berths. The congestion is worse than ever, and there is no doubt that there are a number of steamers now in the Channel which will be lucky if they get loaded and are able to sail before the Easter holidays. The announcement has been made that Sir David Shackleton would meet the representatives of the employers and the workmen at the Ministry of Labour yesterday (Thursday) to consider further the application of the employers for the immediate setting up of a Court of Inquiry to decide the question of the introduction of a third shift.

Colliery Developments.

It is officially announced that the directors of North's Navigation Collieries, Limited, have made an offer to the shareholders of the Imperial Navigation Coal Company, Limited, to acquire their shares on the basis of four 5s. shares in North's Company for every £1 fully paid ordinary share in the Imperial Navigation Company. The chairman of both companies is Mr. H. Seymour Berry, and the Imperial Navigation Company owns the Duffryn Rhondda collieries and Cynon collieries. The effect of this scheme will be to link up the three undertakings of North's, Celtic and Imperial Navigation under a single proprietary control, and there is this advantage that all three properties adjoin. The report of the Powell Duffryn company is interesting as showing that for the year 1922 the output from the various collieries belonging to this concern, exclusive of the Rhymney Iron Company, was 4,544,988 tons, which is the largest output yet obtained in any year. This company has extensive schemes of development in progress, so that in the course of the present year its production is likely to be considerably increased. It is also reported that the celebrated Swansea 6ft. seam has been struck at the Samlet Pit, Llansamlet, and hopes are entertained that the coal found will last for half a century, and in the course of time find employment for 1000 workmen.

Trade Union Warfare.

The South Wales Miners' Federation has for some time past adopted a policy aimed at squeezing out the craft unions, and the position is now reaching an acute stage. A delegate conference of the South Wales and Monmouthshire Mechanical and Surface Workers' Union was held at Cardiff on Saturday last, when the grievance against the South Wales Miners' Federation was fully ventilated, and a resolution was passed instructing the general secretary to convey to the Prime Minister and the Home Secretary a most earnest appeal for a full inquiry into the action and behaviour of certain persons who are members of the Miners' Federation. There has been a stoppage at the Nine Mile Point collieries for several weeks past on account of the warfare between the two unions in question. It was decided to make a restart at the collieries this week, but the settlement has been short-lived, as when the craftsmen, who are members of the Surface Workmen's Union, presented themselves on Tuesday afternoon they were stopped by pickets of the Miners' Federation, and as they declined to forsake their union for the miners' organisation, the craftsmen were not allowed to go to work. The upshot was that the men belonging to the Miners' Federation were compelled to return home.

Current Business.

The firmness of all grades of steam coals is very pronounced, more especially in view of the demand for coals in order to get vessels loaded and sailed before the holidays. The miners will be having two days' holiday in Easter week, but it is pretty certain that fully half a week's output will be lost. The pressure for coals will be exceedingly heavy, not only during the remainder of this month but during April also, as the bulk of collieries have disposed of the whole of their expected output. Some collieries, particularly those producing highly bituminous coals, have none to offer for shipment this side of May. Best Admiralty large coal is nominally 37s. 6d. to 40s., and it is reported that the latter figure has been paid for a small quantity. Best dry large have been done at 35s., on which basis superior Monmouthshire large are quoted. Small coals are particularly strong, and superior qualities are unobtainable at less than 27s. 6d. to 30s. Patent fuel is firm at 37s. 6d. to 40s., and as regards the anthracite section the tone is firmer. The demand for these grades is improving.

Swansea Metal Exchange.

The tin-plate market is very firm. Business has been done at 23s. basis I.C., f.o.b., but manufacturers are in some cases quoting 24s. works' ports, as there is a prospect of tin-plate bars advancing in price. There is a good inquiry for tin-plates.

Coalowners' Annual Meeting.

Mr. Charles Edward Cleeves has been elected chairman and Mr. Robert Gibb, jun., vice-chairman of the South Wales Coalowners' Association for the ensuing year.

Wilbur Wright Memorial Lecture.—The Royal Aeronautical Society announces that the eleventh annual Wilbur Wright memorial lecture will be read this year by Dr. Joseph S. Ames, director of the Physical Laboratory of the John Hopkins University, Baltimore, Md., in the Theatre of the Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2, on Thursday, May 31st, at 5.30 p.m. The subject of the lecture will be "The Relation between Aeronautical Research and Aircraft Design." Tickets may be obtained from the offices of the Society, 7, Albemarle-street, London, W. 1.

The Institution of Mining and Metallurgy.—The following awards have been made by the Council of the Institution of Mining and Metallurgy:—(a) The gold medal of the Institution has been awarded to Mr. Edgar Taylor, President 1909–1911 and 1916–1918, honorary treasurer since 1913, in recognition of his services to the Institution since its foundation in 1892, and as an evidence of appreciation of his honourable record of work in connection with the development of the mining industry, particularly in India; (b) The Consolidated Gold Fields of South Africa Limited gold medal has been awarded to Dr. Leonard Hill, F.R.S., in recognition of his valuable researches on ventilation and for his paper on "Ventilation and Human Efficiency," contributed to the "Transactions"; (c) The Consolidated Gold Fields of South Africa Limited premium of forty guineas has been awarded to Mr. Henry Francis Collins for his paper on "The Igneous Rocks of the Province of Huelva and the Genesis of the Pyritic Ore Bodies," contributed to the "Transactions," and in recognition of his researches on the subject.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	22/6
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	6 0 0	—
No. 1 Foundry	6 3 6	—
No. 3 Foundry	5 18 6	—
N.E. COAST—		
Hematite Mixed Nos.	6 2 6	6 2 6
No. 1	6 3 6	6 3 6
Cleveland—		
No. 1	6 10 0	6 10 0
Silicious Iron	6 10 0	6 19 0
No. 3 G.M.B.	6 7 6	6 7 6
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	6 0 0	6 0 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge *	—	—
,, ,, Foundry	5 10 0	—
(3) Northampton—		
Foundry No. 3 *	—	—
,, Forge *	—	—
(3) Derbyshire—		
No. 3 Foundry	5 5 0 to 5 7 6	
Forge	4 15 0 to 4 17 0	
(3) Lincolnshire—		
Basic	6 0 0 to 6 10 0	
Foundry	4 17 6 to 5 2 6	
Forge	4 15 0 to 5 0 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	6 17 6	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	11 10 0	—
Best ,,	13 10 0	—
Hoops	15 19 0	—
MIDLANDS—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	11 10 0	—
Gas Tube Strip	12 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 0 0	—
Ship Plates ½in. and up	9 15 0	—
Sections	9 5 0	—
Steel Sheets ⅛in. to ½in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 0 0	—
Joists	9 10 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	10 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0	—
Billets	10 0 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 10 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 11 0 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	9 15 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	12 10 0 to 13 0 0	
MIDLANDS—		
Small Rolled Bars	10 15 0 to 11 0 0	
Billets and Sheet-bars	9 0 0 to 9 10 0	
Gas Tube Strip	10 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 0 0 to 19 10 0	
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/- to 24/-
Block Tin (cash)	£34 5 0
,, (three months)	£34 10 0
Copper (cash)	£72 10 0
,, (three months)	£73 2 6
Spanish Lead (cash)	£29 0 0
,, (three months)	£28 15 0
Spelter (cash)	£36 17 6
,, (three months)	£36 15 0
MANCHESTER—	
Copper, Best Selected Ingots	£77 0 0
,, Electrolytic	£80 10 0
,, Strong Sheets	£114 0 0
,, Loco Tubes	£0 1 2½
Brass Loco Tubes	£0 1 0½
,, Condenser	£0 1 2½
Lead, English	£30 10 0
,, Foreign	£29 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£52 0 0	20/-
,, ,, 1 p.c. ,,	£82 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1.6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£16 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	28/-
,, ,, Ell	29/6
,, ,, Splint	34/- to 35/-
,, ,, Trebles	31/-
,, ,, Doubles	30/-
,, ,, Singles	30/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	28/-
,, ,, Splint	32/-
,, ,, Trebles	31/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	34/- to 35/-
Screened Navigation	36/-
Trebles	31/-
Doubles	31/-
Singles	31/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	34/6
Secondary Steam	30/-
Trebles	31/-
Doubles	31/-
Singles	31/-

ENGLAND.

(8) N.W. COAST—	
Steams	30/6
Household	46/8 to 57/6
Coke	42/6
NORTHUMBERLAND—	
Best Steams	32/6 to 35/-
Second Steams	30/- to 31/-
Steam Smalls	22/- to 25/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	33/- to 35/-
Second	32/6
Household	25/- to 28/-
Foundry Coke	70/- to 80/-
SHEFFIELD—	INLAND.
Best Hand-picked Branch	32/6 to 34/6 —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	25/6 to 27/6 —
,, ,, House	23/- to 24/6 —
,, ,, Large Nuts	20/6 to 22/6 —
,, ,, Small ,,	16/- to 19/- —
Yorkshire Hards	21/- to 22/- —
Derbyshire ,,	20/- to 21/- —
Rough Slacks	10/- to 12/- —
Nutty ,,	8/- to 10/- —
Smalls	3/- to 7/- —
Blast Furnace Coke (Inland and Export)	24/- to 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	37/6 to 40/-
Second ,, ,,	35/- to 37/6
Best Dry Large	34/- to 36/-
Ordinary Dry Large	32/6 to 33/6
Best Black Vein Large	35/- to 37/6
Western Valley ,,	34/- to 35/-
Best Eastern Valley Large	34/- to 36/-
Ordinary ,, ,,	31/- to 33/-
Best Steam Smalls	27/6 to 30/-
Ordinary ,,	25/- to 27/6
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	33/- to 35/-
,, ,, Smalls	27/- to 28/-
No. 2 ,, Large	30/- to 32/-
,, ,, Through	27/6 to 28/6
,, ,, Smalls	23/- to 25/-
Coke (export)	70/- to 80/-
Patent Fuel	40/- to 45/-
Pitwood (ex ship)	28/- to 28/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	40/- to 45/-
Seconds	35/- to 40/-
Red Vein	30/- to 32/6
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	45/- to 47/6
Peas	20/- to 22/-
Breaker Duff	11/6 to 12/-
Rubbly Culm	14/6 to 15/-
Steam Coals:	
Large	28/- to 30/-
Seconds	26/- to 27/-
Smalls	17/- to 20/-
Cargo Through	23/- to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal.

French Engineering Notes.

(From our Correspondent in Paris.)

Engineering Trades.

IF it were not for the discrepancies in the prices of iron and steel, which are, moreover, steadily advancing on account of the damping down of so many blast-furnaces through lack of coke, it is probable that the situation of the engineering trades would be quite satisfactory. A vast amount of work has to be carried out, not only in the devastated regions, but also in other parts of the country, and while much of the work has been held back in the hope that the present difficulties would be soon overcome, it is now found, in many cases, impossible to wait any longer, the more so because it is clear that even if supplies of coke were to become immediately abundant, it would take months before all the blast-furnaces could be got into operation again. Until then it may be taken for granted that the lessening supplies of rolled iron will be accompanied by still higher prices. Meanwhile, most of the leading engineering concerns are negotiating contracts that represent quite a large volume, and orders are being distributed for electric locomotives for the Culoz-Modane lines, these being the first to be constructed in France with six driving axles. They are intended for loads of 400 to 500 tons on gradients of as much as 1 in $33^1/_2$. So far as structural work is concerned the situation is by no means so satisfactory, and efforts are being made to ensure a stabilisation of prices, although no definite plan has been put forward to attain that end. It is difficult to see how any stabilisation can be effected under conditions offering so many elements of uncertainty. The only encouraging feature is that an arrangement has been come to whereby Belgium is to supply 30,000 tons of coke per month in exchange for 15,000 tons of scrap. The French are strongly opposed to any exportation of scrap iron, especially under present circumstances, and it is also proposed to place a high export *ad valorem* duty on copper scrap with a view of preventing its being sent out of the country. Meanwhile, so little coke is coming from the Ruhr that stocks of rolled iron and steel are diminishing so seriously that the situation is becoming more and more disquieting for consumers.

Naval Questions.

The programme that has been presented to the Chamber of Deputies providing for the construction of vessels of a total of 700,000 tons during a period of twenty years is not giving satisfaction to those who claim that the naval defence should depend mainly upon submarines and aircraft. At present the "naval statute" only provides for 65,000 tons of submarines and 61,000 tons of seaplane carriers, which is regarded in many quarters as hopelessly insufficient; but it should be remarked that while this tonnage of underwater craft is to be constructed during the next eight years, there is nothing to show that the tonnage may not be increased according to circumstances, although it is regarded, at the moment, as a maximum suggested by the French delegates, but not imposed, at Washington. In a general way the French object to any limitation of submarine construction, but the Government is aware that there is some moral obligation to fix a limit now in order to avoid possible friction. So far as concerns capital ships, the Washington Treaty will be presented to the Chamber of Deputies for approval very shortly, and in any case nothing will be done in the way of building new battleships until the first part of the programme has been completed. If the new "naval statute" is likely to meet with considerable criticism, it can hardly be more violent than the attacks upon the suppression of the superfluous arsenals. Although this matter appeared to be settled a few months ago, there has been a further interminable debate, chiefly through the intervention of representatives of local interests which object to see the old arsenals shorn of their former importance. The new "naval statute" does not need a multiplicity of arsenals, and their suppression will mean a considerable saving every year to the country, to say nothing of the amount that may be realised immediately by the sale of valuable plants. The only arsenals are to be Brest and Toulon. Both Cherbourg and Bizerte are to become "bases." At Cherbourg work will be provided by the construction of submarines, and Bizerte will be reduced to its pre-war importance, while it will be chiefly valuable for the storage of oil fuel. Lorient will become an "establishment" like Indret and Ruelle, that is to say, it will be run on industrial lines for ship repairs and similar work, and it will be regarded as a "regulator of prices;" in other other words, it will serve to prevent any inflation of prices by private industry. The Guérigny armour plate and chain works are to be sold, if possible. The manufacture of chains will be transferred to Indret. There is to be a considerable reduction in the number of hands, as well as in the staffs, and although the Government has announced its intention to reduce work in the State establishments and to give out as much as possible to private industry, it is to be noted that while the submarines were put on the stocks as soon as the credits were voted, there has been a long delay in distributing orders to machinery firms and to private shipyards.

Flood Protection.

The floods caused by the rising of the Seine, Loire and other rivers are more serious than any yet experienced since the disastrous inundations of 1910, when the low-lying parts of Paris were under water, and while in the city engineers have been able to avert a catastrophe, they have been powerless to cope with the rising masses of water which have, in some cases, isolated towns and villages and have caused incalculable damage. So far as Paris is concerned, a complete scheme of protection works was approved of after the inundation of thirteen years ago and formed part of the undertaking to convert the capital into a seaport by deepening the Seine to Rouen and constructing a canal from the Marne to the Seine at Gennevilliers, where vast basins were to be constructed. The carrying out of this scheme has been delayed by want of funds, but the alarm of the past week will probably do something to push forward this important undertaking.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

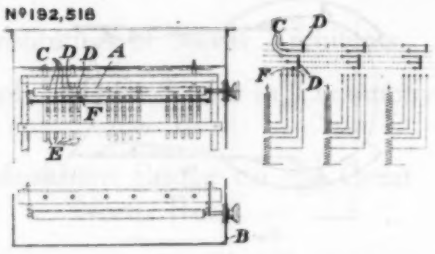
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

192,518. November 11th, 1921.—IMPROVEMENTS IN TAPPING SWITCHES FOR CHANGING VOLTAGE RATIOS OF TRANSFORMERS AND THE LIKE, Stanley Austen Stigant, of 2, Aberdeen-terrace, Blackheath, London, S.E. 3; Edwin Barton, of 3, Highams Station-avenue, Chingford-road, Chingford, Essex; and Johnson and Phillips, Limited, of Charlton, London, S.E. 7.

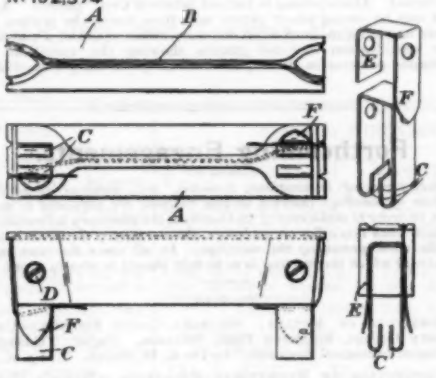
AN insulating drum A is rotably supported by the transformer structure and within the tank B. This drum carries contact studs C and bars D. On rotation of the drum A these



contacts connect up different pairs of tapping leads E from the high or low-tension windings by means of contact fingers F which are mounted on an insulating terminal board. The scheme will readily be understood from the diagram of connections on the right.—*February 8th*, 1923.

192,574. January 5th, 1922.—FUSE CARRIER FOR DISTRIBUTION BOARDS, William Gee, Lyndon Lodge, Golden Manor, Hanwell, Middlesex.

The chief object of this invention is to provide simplified means for attaching the fuse wire to fuse carriers. The carrier A has contacts C, of well-known type, fixed by screws D. To each of these contacts a U-shaped clip E is fitted, and each clip has a slightly bent out end F forming a small V-shaped space between

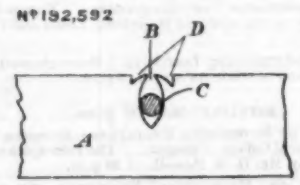


it and the adjacent contact. The fuse wire is simply pushed or pulled into this space at one end, laid over the end of the carrier, along the groove B, over the other end of the carrier, and into the similar small space at the other clip and contact. The spring-like nature of the clips and their contacts is sufficient to grip the fuse wire and hold it tightly without the assistance of screws or other such means.—*February 8th*, 1923.

TELEGRAPHS AND TELEPHONES.

192,592. June 24th, 1922.—IMPROVEMENTS IN AND RELATING TO THERMIONIC VALVES FOR WIRELESS TELEGRAPHY AND TELEPHONY, Lionel George Preston, Royal Navy; Benjamin Hodgson; and Henry George Hughes, all of H.M. Signal School, Royal Naval Barracks, Portsmouth, Hampshire.

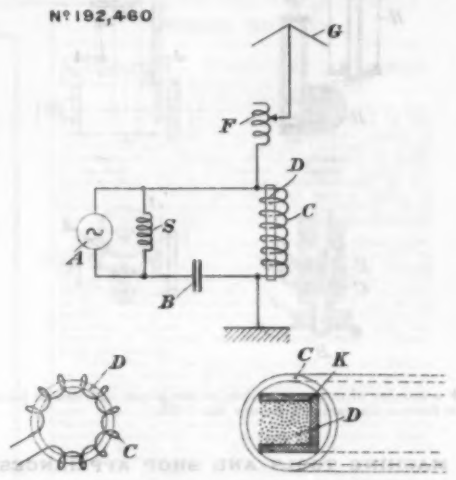
This invention relates to a grid construction for thermionic valves, and the object of the invention is to provide an arrangement which is rigid and otherwise satisfactory and which is not too tedious to manufacture. Usually grids for thermionic valves are made by lacing the wire which forms the grid to the grid supports by very fine lacing wires. Such a construction is



not considered sufficiently rigid and is not always satisfactory from the point of view of manufacture. In the construction shown the support A for the grid may be of any convenient cross section, as, for example, rectangular. In this support one or more slots or saw cuts B are made. The grid wire C is placed in the slot or slots B and the edges D of the slot or slots are burred or bent over in any suitable way as by a blow with a suitable tool.—*February 8th*, 1923.

192,460. October 29th, 1921.—APPARATUS FOR THE PRODUCTION OF HIGH-FREQUENCY OSCILLATIONS BY MEANS OF ALTERNATING CURRENT OF LOW FREQUENCY, *Herbert Sefton-Jones, of Sefton-Jones, O'Dell and Stephens*, 285, *High Holborn, London, W.C.*

This specification describes apparatus for producing high-frequency oscillations from alternating current of lower frequency with the aid of a transformer having a core so dimensioned that it is saturated by a small part of the low-frequency current and the short period electromotive force is applied to the high-frequency circuit to produce high-frequency oscillations which extend over the longer interval in which the transformer flux suffers no change. A source A of alternating current, such as a high-frequency alternator to which a self-inductance S can be joined in parallel, is connected with a condenser B and a coil C which contains an iron core D. This system is tuned to the frequency of the alternating current source A so that for a given electromotive force of the alternator large currents are developed and the core D is saturated for a long time. The iron core



D of the transformer C is preferably composed of a ring of thin separate wires which are insulated from one another. The winding C, for the purpose of more effective cooling and insulation, is not wound directly upon the iron core, but is kept at a certain distance from the core by means of the insulation K. It is advisable to cool the transformer by means of oil. The oscillatory system in which the higher frequency is to be produced, such as an aerial system, comprising the antenna G, the coil F, and the earth connection, can be connected either to a secondary winding of the transformer or simply be directly attached to a part or the whole of the coil C. The system C, D, F and G must then be tuned to the higher frequency, which must be an odd multiple of the basic frequency. As the self-induction of C is only small when the iron core D is saturated, but little of the higher frequency energy flows round the alternating-current source A and the condenser B.—*January 23rd*, 1923.

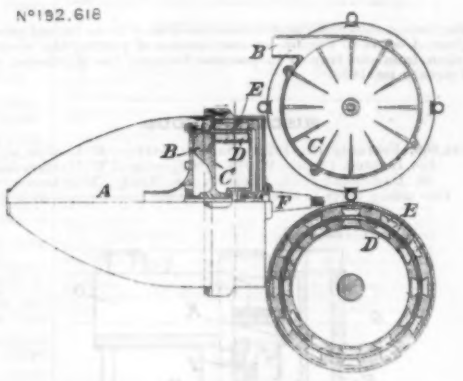
171,983. November 2nd, 1921.—IMPROVEMENTS IN WIRELESS RECEIVING SYSTEMS, Gesellschaft für Drahtlose Telegraphie, m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

This invention relates to improvements in wireless receiving systems, and its object is to provide a receiving system in which atmospherics are prevented from affecting the receiving circuits. A frame type aperiodic aerial is employed, in which the damping is so great that when the aerial is shocked by an atmospheric there is no shock excitation of the secondary receiving circuits. The damping of these circuits is small, and as the strength of the oscillations due to incoming signals is diminished, cascade amplifying valves are employed, which operate at different frequencies.—*February 2nd*, 1923.

PUMPING AND BLOWING MACHINERY.

192,618. February 17th, 1922.—CENTRIFUGAL PETROL PUMPS, S. G. Wybrow, Air Ministry, Alexandra House, Kingsway, London, W.C. 2.

This pump is specially suitable for pumping petrol, as it has no stuffing-box. The inlet is shown at A and the outlet at B. The impeller C runs on ball bearings and has round its periphery a series of permanent magnets D D. Outside the pump casing



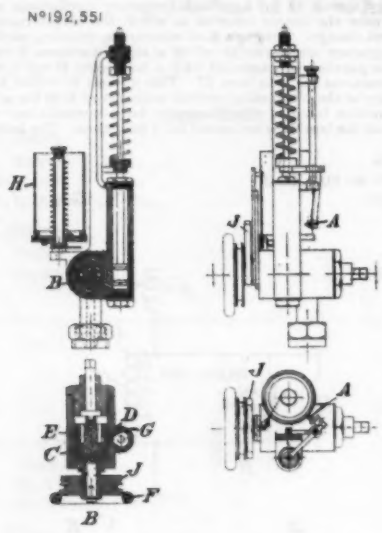
there is a separate rotor with corresponding magnets E E. This rotor is keyed on to the shaft F of a windmill that is used to drive the pump. Magnetic attraction drives the impeller without it being necessary to have an opening in the casing.—*February 8th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

192,551. December 12th, 1921.—INDICATORS, C. H. Gale, St. John's, Bishopstoke, Hants.

The inventor claims that this instrument is specially suitable for indicating high-speed internal combustion engines. It produces a diagram representing the average of a number of cycles. The pencil A is connected directly with the piston-rod of the indicator. The cylinder is put into communication with the engine combustion space intermittently at any predetermined point in the cycle by means of the valve B. This valve comprises a plug C that is driven continuously at engine speed and has a port D. The outer sleeve E is adjusted by means of the hand wheel F so that its port G corresponds with any predetermined point in the cycle. When the ports D and G register the engine pressure is communicated to the indicator and the pencil moves

to a corresponding position. At the same time the paper drum H is moved by a cam J and cord connection to a position representing the position of the engine piston. By moving the hand wheel



F a number of marks are made on the paper and can be joined to form a diagram.—*February 8th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

192,217. February 16th, 1922.—Improvements in and relating to Electric Rivet Heating Machines of the Resistance Type, John Wright Poole, of 28, Queen's-road, Erdington, Birmingham; William John Readett, 58, Tennyson-road, Small Heath, Birmingham; and Buckley Saunders and Co., 46, Constitution-hill, Birmingham.

In order to avoid rivets being unevenly heated it is proposed to encircle the lower end of the rivet by a heat-conducting ring composed, say, of copper, the object of the ring being to draw some of the heat away from the lower end of the rivet. The lower

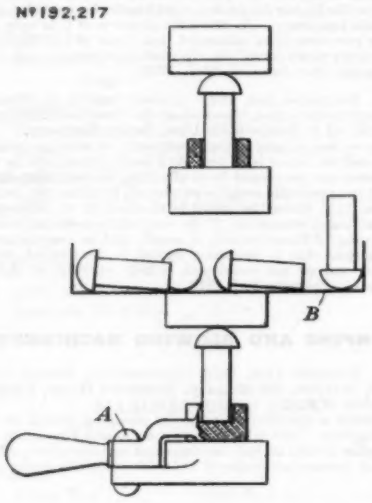
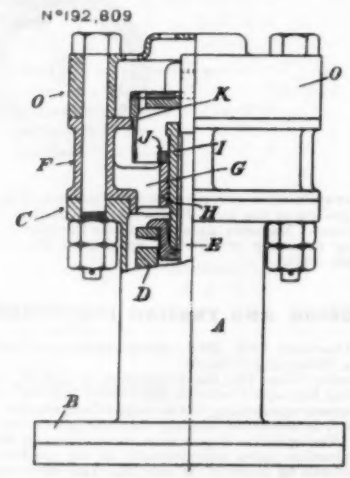


illustration shows the heat extractor adopted to be turned on a pivot A so as to provide an easy means of putting the rivets taken from the tray B in position between the electrodes.—*February 1st*, 1923.

MISCELLANEOUS.

192,609. February 4th, 1922.—Safety Valves, R. L. Ross and Co., Limited, Premier Works, Stockport, and W. Hargreaves, 19, Dartmouth-road, Chorlton-cum-Hardy, Manchester.

This safety valve is intended to prevent interference with its

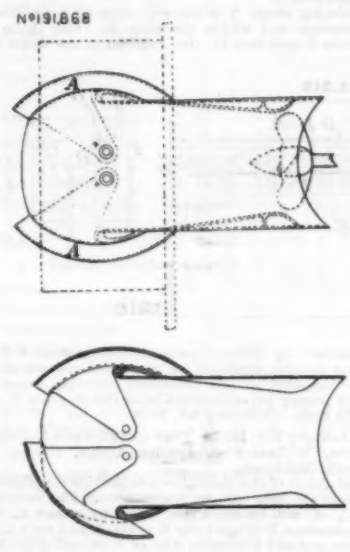


adjustment unless the boiler pressure is blown off in the process. The main valve casing A, which is provided with the main valve seat and a flanged base ring B, is formed with an upper flange ring C. The valve casing A encloses the valve seat, the spring, shown partly at D, and the lower portion of the valve spindle E which bears on the main valve. At the top of the main casing A on the flange C is seated the intermediate ring F, which is formed with webs G supporting a central boss H. The central boss is bored and threaded vertically and a central threaded valve adjusting sleeve I fits into it, the valve spindle E passing upwards therethrough. A lock-nut J is provided on the threaded central sleeve. The intermediate ring F receives a secondary area valve K. Surmounting the intermediate ring and entirely enclosing the secondary area valve K, the valve spindle E, and the valve adjusting means I, is the top enclosing cover O.—*February 8th*, 1923.

SHIPS AND BOATS.

191,868. October 29th, 1921.—Manœuvring Propellers, E. S. G. Rees, The Rees Roturbo Manufacturing Company, Limited, Wednesfield-road, Wolverhampton.

The inventor places an "augmenter tube" aft of the propeller and so forms it, with an enlarging cross section, that the velocity energy of the stream leaving the propeller is converted into pressure energy. The stern opening from the tube is so proportioned that the pressure energy is again converted into



velocity energy of a quality most suitable for the propulsion of the vessel. This opening is formed between two "pallets" A A that can be swung about pivots and thus direct the stream of water in such a manner as to dispense with the use of a rudder. The specification includes graphs showing the variation of hydraulic pressure in the augmentor tube.—*January 25th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the time and place *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institute of Metals: Swansea Local Section.—University College, Singleton Park, Swansea. Paper, "Gaseous Firing of Industrial Furnaces," by Dr. E. W. Smith. 7.15 p.m.

Institution of Mechanical Engineers.—Storey's Gate Westminster. Report of Steam Nozzles Research Committee, 6 p.m.

Institution of Municipal and County Engineers.—East Midland District meeting at Ashby-de-la-Zouch. 11.15 a.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Comparative Power Costs," by Mr. C. H. Woodfield. 7.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Novels and Stories of J. Sheridan le Fanu," by Dr. M. R. James. 9 p.m.

Junior Institution of Engineers: North-Eastern Section.—Armstrong College, Newcastle-on-Tyne. Paper, "Steel Making," by Mr. H. Hall. 7.15 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society, Newcastle-upon-Tyne. "Notes on the Economical Performance of Turbine Installations in Merchant Ships," by Mr. T. S. Potts. 7.30 p.m.

SATURDAY, MARCH 17th.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Lecture, "Atomic Projectiles and their Properties" (V.), by Sir Ernest Rutherford. 3 p.m.

Junior Institution of Engineers: North-Eastern Section.—Visit to the works of Hawthorn, Leslie and Co., Newcastle.

Borough Polytechnic Institute.—Borough-road, S.E. 1. Annual exhibition of students' work. 3 p.m.

MONDAY, MARCH 19th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. "The Principles of Vehicle Suspension," by Mr. H. S. Rowell. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Graduates' meeting. "The Walschaerts Locomotive Valve Gear," by Mr. R. C. Bond. 7 p.m.

Bradford Engineering Society.—The Technical College, Bradford. "High-speed Air Compressors," by Mr. J. M. Walshe. 7.30 p.m.

Northampton Engineering College Engineering Society.—St. John-street, E.C. 1. Paper, "Reconstruction Work at Beckton Gasworks," by Mr. W. B. Leech. 5.30 p.m.

TUESDAY, MARCH 20th.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, E. 1. "Operation of Marine Oil Engines, Cylinders and Pistons," by Mr. John Lamb. 6.30 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Graduates' and students' meeting. Lecture, "Town-planning and Remodelling in relation to Traffic" 5.30 p.m.

Institution of Electrical Engineers: North Midland Centre.—Hotel Metropole, King-street, Leeds. "Permissible Loading of British Standard Paper-insulated Electric Cables," British Electrical Research Association's report, presented by Messrs. S. W. Melsom and E. Fawssett. 7 p.m.

Newcomen Society.—Prince Henry's Room, 17, Fleet-street, E.C. 4. Paper, "The Early History of the Gas Process," by Mr. D. Brownlie. 5.30 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. Papers: "The Improvement of the Water Supply to the City of Hobart, Tasmania, and the Manufacture of Reinforced Concrete Pipes by the Centrifugal Process," by Mr. J. C. Ross; "The Mazoe Irrigation Dam" by Mr. M. Randall; "The Works for the Augmentation of the Supply of Water to the City of Capetown, South Africa," by Mr. D. E. Lloyd-Davies. 6 p.m.

WEDNESDAY, MARCH 21st.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Graduates' meeting. Debate, "Fixed *v.* Detachable Cylinder Heads," opened by Messrs. T. G. Bradley and J. T. Buswell. 7.30 p.m.

Institution of Automobile Engineers: North of England Centre.—Y.M.C.A. Hall, Albion-street, Leeds. Paper, "Principles of Vehicle Suspension," by Mr. H. S. Rowell. 7.30 p.m.

Institution of Automobile Engineers: Wolverhampton Centre.—Star and Garter Hotel, Wolverhampton. Paper, "Gear-boxes for Motor Cycles," by Mr. J. Cohen. 7.30 p.m.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Informal meeting. 7.30 p.m.

University of London.—Institution of Electrical Engineers, Savoy-place, W.C. 2. "The Control of the Speed and Power Factor of Induction Motors." Lecture IV., "Phase Advancers and Alternating-current Exciters, &c.," by Professor Miles Walker. 5.15 p.m.

Society of Glass Technology.—The University, Edmund-street, Birmingham. General meeting. 2.45 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. Informal discussion on "Electric Train Lighting," introduced by Mr. J. R. W. Grainge. 7 p.m.

WEDNESDAY TO FRIDAY, MARCH 21st TO 23rd.

Institution of Naval Architects.—Royal United Service Institution, Whitehall, W.C. 2. Annual meetings. For programme, see page 269.

THURSDAY, MARCH 22nd.

Institution of Locomotive Engineers.—The Engineers' Club, Coventry-street, W. 1. Paper, "The Theory and Practice of Steam Jet Instruments," by Mr. J. N. Gresham. 7 p.m.

Faraday House Old Students' Association.—Hotel Cecil, W.C. 2. Annual smoking concert. 8 p.m.

FRIDAY, MARCH 23rd.

Institute of Metals: Sheffield Local Section.—Mappin Hall of the University, St. George's-square, Sheffield. Paper, "Further Notes on Britannia Metal," by Captain F. Orme. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The History and Development of the Underground Railway," by Mr. R. J. Siddall. 7.30 p.m.

Institution of Production Engineers.—The Engineers' Club, Coventry-street, W. 1. Paper, "Modern Gauging Systems," by Mr. A. C. Wickman. 7.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. Discourse, "Life History of an Alpha Particle from Radium," by Sir Ernest Rutherford. 9 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "The Future of Steam as Applied to Motor Vehicles and Agricultural Engines," by Mr. K. W. Willans. 7.30 p.m.

SATURDAY, MARCH 24th.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. "Atomic Projectiles and their Properties" (VI.), by Sir Ernest Rutherford. 3 p.m.

LAUNCHES AND TRIAL TRIPS.

Glencorrie, single-screw steamer; built by Swan, Hunter and Wigham Richardson for service on the Canadian lakes and canals; dimensions, 250ft. by 42ft. 6in. by 20ft. 6in. Engines, triple-expansion, pressure 180 lb.; constructed by MacColl and Pollock, Limited; launch, March 1st.

Automedon, steel screw steamer; built by Palmer's Shipbuilding and Iron Company, to the order of the Ocean Steamship Company, Limited; dimensions, 476ft. 6in. by 58ft. by 35ft. 3in.; 10,000 tons deadweight. Engines, single-screw double reduction geared turbines, pressure 220 lb.; constructed by the builders; trial trip, March 2nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are informed by Hyatt, Limited, 56, Victoria-street, that it has now taken over the sales organisation for N.D. ball bearings for this country, the British Dominions and continental Europe.

The Stanley Engineering Company asks us to state that it has purchased the whole of the premises and plant of the Griffin Engineering Company, Limited, Bath. Its new postal address after the end of this week will be the Stanley Engineering Company, Monksdale-road, Oldfield Park, Bath. Its telephone number and telegraphic address will remain as before.

Loughborough College: Presentation Day, March 10th, 1923.—After presenting the diplomas to some 250 students at Loughborough College, Sir Montague Barlow, said that the college had rendered splendid service in the early days of the war in training munition workers. He believed the engineering equipment to be unsurpassed within the kingdom, and considered that the authorities were carrying out a very interesting experiment in undertaking a course which combined in close combination, theoretical study and practical experience. During the war over 2300 workers of both sexes were training at the college, and the work more recently undertaken in training both ex-officers and disabled men had been most admirable. The keynote of the college appeared to be that there should be no production without a corresponding consumption, and that if work was to be produced at all, it must be produced of sufficiently high standard to guarantee a sale.